THE AMERICAN GAS LIGHT JOURNAL

REDMAN & KENNY, N.Y.

PUBLISHING OFFICE No. 32 PINE STREET

DEVOTED TO THE INTERESTS OF ILLUMINATION, VENTILATION, WATER SUPPLY AND DISTRIBUTION, & GENERAL SCIENCE.

VOLUME LXV.—No. 21. Whole No. 1,120. | NEW YORK, MONDAY, NOVEMBER 23, 1896. | $3 PER ANNUM, IN ADVANCE.

A. M. CALLENDER & CO., Proprietors. C. E. SANDERSON, Manager.
JOS. R. THOMAS, C.E., Editor. T. J. CUNNINGHAM, Asst. Editor.

ENTERED AT THE POST OFFICE AT NEW YORK, N. Y., AS SECOND-CLASS MATTER.

Published on each Monday of the year, at No. 32 Pine Street, New York.

Collections are invariably made directly from this office for subscriptions, advertisements, etc. We have agents to solicit the same, but they are not authorized to receipt for money.

Terms of Subscription, Including Postage —For the United States and Canada, $3 per annum. European countries, $4.50 (19 shillings—22½ francs). All payments to be made in advance. Single copies, 10 cents.

The American News Company, Nos. 39 and 41 Chambers street, New York, are agents for this JOURNAL. Newsdealers will send orders to them.

Correspondence.—Wishing to make this JOURNAL a gazette of intelligent discussion to those of our readers who may wish to gain or give information on the subjects to which its columns are devoted, correspondence is solicited for publication from all who make the study of those subjects a pleasure or a profession.

Remittances should be made either by post office order, express money order, registered letter, or bank draft on New York, payable to the order of A. M. Callender & Co.

Books.—We will forward by express, at publisher's lowest rates, any book—scientific or otherwise—to any address in the United States or Canada. We would suggest to our patrons that to avoid the risk and expense consequent on sending us the money (we do not send books C. O. D.), that orders for books be sent us through the Purchasing Department of the American Express Company.

The Public Lighting Tables of the American Meter Company will be found in the page advertisement of that Company.

CONTENTS.

An Asterisk (*) denotes an illustrated article.

EDITORIALS—

Briefly Told 801

Mr. Egner's Paper on "Inclined Retorts up to Date"—Progress in the Matter of the Gas Exhibition—Notes.

Twenty-fourth Annual Meeting, American Gas Light Association—Abstract of Proceedings—Continued from page 766 802

Second Day, Morning Session—*Inclined Retorts up to Date, by Mr. Frederick Egner—Discussion.

*Rapid Measuring Pipette 813

*Dixon's Nut and Pipe Wrench 813

The Origin of Waves of Light 814

The Velna Process for the Manufacture of Briquettes from Waste Coal and Mineral Tar 815

ITEMS OF INTEREST FROM VARIOUS LOCALITIES 816

Proposed Gas Company for Mason City, Iowa—Contract for the Economical Gas Apparatus Construction Company—The Missouri Gas Company's First Half-Yearly Return—Receiver's Sale, Stoneham, Mass.—Joined in Marriage—The Decision on the Brookline Company's Petition for a Bond Issue—The Anthracite Gas Producer Company—Sale of the Rye and Portchester (N. Y.) Works—New President for the Johnstown (Pa.) Company—To Increase the Capital Stock, Ilion, N. Y.—Forty Fort (Pa.) to Have Gas—Changes at Woburn, Mass.—Gas Company for Newport News, Va.—Annual Meeting, Elizabeth, N. J.—Gas Inspector for Kansas City, Mo.—Production of Petroleum Oil in Canada—Price of Gas Increased—An Interesting Legal Contention—Hints from Newport, R.I.—And Other Items.

Acetylene 817

The Market for Gas Securities 818

BRIEFLY TOLD.

MR. EGNER'S PAPER ON "INCLINED RETORTS UP TO DATE."—The current chapter of our abstract of proceedings of the St. Louis meeting of the American Association contains the paper, by Mr. Frederick Egner, on "Inclined Retorts up to Date," together with as much of the discussion thereon as it is within our province to give. The most perfunctory reading of the Egner paper will not fail to produce the impression that the author spared himself neither time nor study in its preparation, and the careful reader will readily acknowledge that Mr. Egner has quite well realized in its matter the purpose he had in view—that of bringing up to current time the history of inclined retorts. The paper as originally printed from the manuscript contained errors of calculation, resulting from a misunderstanding of the schedules submitted, the errors appearing in Tables Nos. 10, 11 and 12, and in the summarized Table (No. 19), but these have been corrected in the paper as it is given in the JOURNAL. The author also noted the discrepancies by calling attention to the same verbally when the paper was being considered at the meeting. As said before, Mr. Egner was thorough in his treatment of the subject, and that he was honest and unbiased may not for a moment be doubted; yet we imagine that the day is not at hand in this country when the "inclines" will be regarded with greater favor, for all-round hard work, than the up-to-date horizontal equipment of retort house plant for coal gas manufacture. However, that opinion has no bearing whatever on the intrinsic merit of Mr. Egner's well thought out communication, which can be read with pleasure and profit by all who are practically interested in the development and working of gas manufacturing apparatus. The discussion on the Egner paper brought out some differences of opinion as to the good policy of the practice of permitting the reading or submission of set contributions as discussion, *per se*. While all must admit that the discussion-paper submitted by Mr. A. C. Humphreys was well worth listening to, it nevertheless put Mr. Egner at a disadvantage when it came to replying thereto, for the situation was really one calling for off-hand responses to some well studied out objections. In fact, it looks that, to be perfectly fair for writers of papers and the discussers thereof, the latter should prepare their arguments sufficiently in advance of the meeting to enable the former to re-fortify themselves. The great difficulty in the way of that procedure, however, would seem to lie in the fact that the meetings of the Association would become "things without end" for those who elected either to prepare papers or to discuss them.

PROGRESS IN THE MATTER OF THE GAS EXHIBITION.—Unless "indications are not what they seem," the success or failure of the proposed gas exhibition, at the Madison Square Garden, in New York, next winter, no longer hangs in the balance, in so far as an excellently representative and numerous class of exhibitors is concerned. No less than 60 separate concerns interested in staples and specialties connected with the gas industry have received allotments of space for the display of their wares, and two of these exhibitors have their headquarters in England—Messrs. George Bray & Co., and Messrs. John Wright & Co., of London and Birmingham. We make individual mention of the two firms, merely to show that our English brethren are not at all averse to doing business on U. S. account. The executive

committee announces that the demonstration lectures on cooking by gas, which feature it has been wisely determined to exploit with every degree of prominence during the time of the Exhibition, are to be under the direction and control of Mrs. S. T. Rorer and Miss L. C. Andrews, the naming of whom is sufficient guarantee that what they have to do will be well done. It is also announced that the postal card vote of the Ohio Gas Light Association, on the proposition to hold the next annual meeting of the Association in New York during the time of the Exhibition, instead of in Ohio, in March, resulted in an emphatic affirmative.

NOTES.—The Directors of the Consolidated Gas Company, of Baltimore, Md., have declared a semi-annual dividend of 2½ per cent., payable December 1st.——In our item columns will be found mention of a suit against the city of Lexington, Ky. At the time the item was written we were not advised as to the outcome of the case, but subsequent information is to the effect that the jury was unable to agree, although it is known that eight jurors favored the contention of the defendants. In the item we should also have said that the Lexington Gas Company was jointly impleaded with the city of Lexington.——A correspondent forwards the following from Houston, Texas, under date of the 16th inst.: "Some days ago certain speculators appeared before the Houston City Council and asked for a franchise for a fuel gas plant, the spokesman for the concern, one W. H. Baker, asserting that the Hall Chemical Company—such is the trademark under which the application was made—stood ready to invest several thousands of dollars in the construction of a plant. It was also averred that the rates at which an excellent article of fuel gas was to be sold would not exceed 35 cents per 1,000 cubic feet to 'large' consumers, or 50 cents per 1,000 to 'small' consumers. The impression prevalent here is that the 'Hall' in the scheme is T. G. Hall, formerly of Canada, latterly, of 'elsewhere,' and 'latest' of Buffalo, N. Y., where he is said to have operated a fuel gas works 'of considerable magnitude.' I imagine that the Houston Gas Light Company would gladly receive any information about Hall and his process that any of the fraternity should see fit to forward. In the meantime, Mayor Rice, of Houston, at the instance of the Council, is endeavoring to locate the solidity of the Hall Chemical Company, through correspondence with the authorities of other cities in which that concern is said to have operated.—J. T. W."——The Berlin Iron Bridge Company, of East Berlin, Conn., is putting up a new machine and blacksmith shop for the Robert Palmer & Son Shipbuilding Company, of Noank, Conn. Other contracts recently secured by the Bridge Company are: A rolling mill for the Rome (N.Y.) Brass and Copper Company; an iron roof for the new armory at Rutherford, N.J.; and a new power house for the Plattsburgh (N.Y.) Light, Heat and Power Company.——The authorities of Winnipeg, Manitoba, have determined to submit to the vote of the ratepayers a proposition to issue $375,000 bonds, the proceeds from the sale of which are to be used in the construction of a gas plant, to be operated on municipal account.——In the quarterly report of Mr. William H. Merrill, electrician to the National Board of Fire Underwriters, concerning fires caused by electrical currents—the quarter embraced in the returns ended October 10th—the following interesting cases are among those mentioned: "Heating effect of an incandescent lamp: A stage hand in a theater, at the close of a performance, was ordered to put out an incandescent lamp near the switchboard on the stage. Instead of using the switch to cut off the current, probably because of ignorance, he wrapped a damp towel around the globe of the lamp, thus shutting off the light. Two hours afterward the night watchman found the towel lying on the stage, smouldering. The glass globe had become so softened by the heat as to drop down at the neck, forming a right angle bend. Heating effect of an incandescent lamp: A portable lamp used in the basement of a store was allowed to remain lying on a mattress. The heat from the lamp ignited the cloth and excelsior of the mattress and the fire spread throughout the basement and store above."——The November number of the *American Journal of Sociology*, published in Chicago, contains an interesting article on the "Productivity of Municipal Enterprises," prepared by Walter F. Willcox, of Cornell University. The author brings out in his paper a very clever arrangement and compilation of the statistics afforded by the labors of the Massachusetts Board of Gas and Electric Light Commissioners, as shown in the annual reports of the Commission.——The Board of Directors elected at the annual meeting of the Troy (N. Y.) Gas Company subsequently perfected the following organization: President, Edward Murphy, Jr.; Vice-President, William Kemp; Secretary and Treasurer, C. E. Davenport.——The advance announcements respecting attacks on gas rates in New York by the newly elected legislators are rather earlier this year than usual.

[ABSTRACT OF PROCEEDINGS.—Continued from page 766.]

TWENTY-FOURTH ANNUAL MEETING, AMERICAN GAS LIGHT ASSOCIATION.

HELD IN THE PLANTERS' HOTEL, ST. LOUIS, MO., OCTOBER 27, 28 AND 29, 1896.

SECOND DAY, OCTOBER 28—MORNING SESSION.

The paper by Mr. Frederick Egner, of Norfolk, Va., on

INCLINED RETORTS UP TO DATE

was then taken up.

At a meeting of this Association, held at Savannah six years ago, the writer presented a paper on "Inclined Retorts," and in view of the now well established success of this great improvement in method for making coal gas, the very little which has been said upon the subject by our American technical journals, and the importance of same to the gas industry, the paper herewith presented to you was prepared.

As it is often profitable to know how not to do a thing, let us first review the failures—and their causes—of the "inclines." Speaking of my own experience with that system of retort setting, there were five principal reasons why our "inclines" were not successful. In the first place, the long twisted charging mouthpieces, as per the original design of Cozé, which had worked reasonably well on our single experimental bench for two years, when set back to back with only a few feet of space between, soon developed objectionable features, not known or suspected by us before. Not suspected because we had been led to believe that similar settings had been, and were at that time, operated with entire success at Rheims, France, by M. Cozé.

This carries us to error number two, connected with which the misleading impressions mentioned before bore a prominent part. Not only were the retorts set too closely together at the back of the bench, but no provision had been made to prevent the sliding forward of any part of the setting, or to relieve the clay retorts from the weight of the heavy iron work.

As might have been expected, every one of the eight settings did slide forward into the fire room; two of the benches as much as 6 inches. Let it be noted here that for years before that time we had invariably supported the retort iron work of our old horizontal settings independently of the bench brick work, and we would not have neglected doing it with the "inclines" but for the belief as to the operation of the design furnished us. Indeed, we talked of doing it anyhow, but because of the considerable additional cost, and the alleged lack of necessity to do it, that precaution was not taken.

The latter probably led to cause number three, viz.: Failure of the furnace. The furnace was designed by the late Mr. Arndt, then engineer of the Chicago Gas Light and Coke Company. It was known to have been used for some years with entire satisfaction, and we accepted it in consequence without question; but when the retorts and tiles in the upper part of the furnace slid forward bodily, it seems that the vertical air and discharge flues of the furnace were ruptured, and as the design was such that it was impossible to make repairs, the furnace was ruined as to the regenerative feature of it. During the first seven days of operating the "inclines" about 20 per cent. of the coke made was used, and that closely approximated to 12 per cent. of fuel per coal carbonized, the results claimed for that furnace.

The fourth cause of failure was the position of the "take-off pipes," which we had changed to be, instead of connected to the lower and frount mouthpieces of the bench, to the upper and back mouthpieces of same. (See Plates 1 and 2). It was found that the gas and vapors passing off in that way were subjected to so much heat that pitch was formed and deposited in the hydraulic main, although the latter was not at all too hot. Pitch in the main cause stopped ascension pipes, smoke on top of the stack, and drove the men from their work. That that was the cause of pitch in the main was cleary proved after two of the benches were altered in accordance with the original design, when that trouble ceased at once. At that period of our operation the Company had declined to spend another cent on the "inclines," but, at the writer's solicitation, permission was given to make the change mentioned, and through the liberality of a gentleman interested in the success of the "inclines," the change was effected, with the result stated.

Finally an exhauster connected with the "inclines," but not in operation at the time, was blown up by means of an explosive placed near it. This happened between the hours of 2 and 3 A. M., one morning, when no one was supposed to have any business in that engine room, and there was not even a light there.

The errors in design, which were responsible more than anything

else for the failure of our Cozé benches, I will say, *which were alone the cause of the failure*, caused also the failure of two similar benches at the works of the Washington, D. C., Gas Light Company, only that at Washington the heavy charging mouthpieces bore the principal part. The writer has the story of that failure, furnished through the courtesy of the General Manager of the Washington Company, Mr. John Leetch, and by Mr. Holden, Superintendent of the East Station of said Company, but it is so very much like our own that it may as well be omitted to save time.

The most notable failure of the "inclines" was that at the "Kensal Green Station" of the "Gas Light and Coke Co." of London, England, where an installation of 460 retorts was introduced upon a plan similar to ours, the whole of which was condemned and stopped work. In a letter written to *The Journal of Gas Lighting*, of London, Mr. Maurice Graham said (July 2, 1895) "*The old Cozé pattern of incline retorts with bent cast iron mouthpieces was a failure everywhere.*" Mr. Graham is a member of the firm of Little & Graham, who have erected 95 per cent. of the now successfully operated "inclines"—or let us call them as they do in England, viz.: "slopers"—and he may be considered an authority on the subject. From the Journal just mentioned, we learn that the "slopers" are now in successful operation at Bromley, Coventry, Chatterly, Droylesden, Gateshead, Huddersfield, Leigh, Middlebrough, Newcastle-Under Lyme, Rochdale, Salford, Tunstall, West Hartlepool, West Greenwich, Bow Common, and including Brentford and Southall; and of this list Mr. W. R. Herring, Engineer and Manager of the Huddersfield Corporation Gas Works, remarks: "*There are not less than eight works where the system has been extended after a lengthened trial.*"

The same gentleman is also quoted in the following: He had put in 180 fifteen foot (retorts 15 feet long) "slopers," in 1893, and after a satisfactory experience added 216 more on the same principle, and the coming (now past) winter expected to make at least 4,000,000 cubic feet of gas per day in the "slopers." The difference in the nature of the work may be gathered from his remarks, where he said that now the men, instead of stripping, as they frequently did when operating the horizontals, often worked with their coats on; and the work of charging the slopers, compared with the horizontals, was really only woman's work. In an eight hours' shift the men worked actually only four hours. It would be well to remember the following remarks by Mr. Herring, as reported in the *Journal of Gas Lighting*, mentioned before: "Some men are apt to think that if they introduce improvements they ought to reach perfection immediately; to have none of the defects of the old system, and that everything should work perfectly smooth. But as a matter of fact, in everything new that is introduced every little thing that goes wrong is immediately reported to the Manager, and that official was apt to think that there were far more difficulties than with the old system, whereas the men had become used to the difficulties with the old plant, and managed to get over them."

In a letter of June 19, 1895, to and published by the *Journal of Gas Lighting*, Mr. Herring concludes with these words: "I may therefore fully claim that the system has also survived at Huddersfield, in the full sense of the term as used by evolutionists."

In the November 19th number (1895) of the *Journal of Gas Lighting*, appeared an interesting account of a visit of the editor of said publication to the gas works at Huddersfield. In the photographic view published with Mr. King's account of what he found on that visit, it will be seen that certain omissions mentioned in connection with our "inclines" were provided for in a substantial manner at the English works. The same is confirmed in the text of Mr. King's article, in which he confirms any good opinion one may have acquired concerning the "slopers," through the reading of the papers, letters, or other communications previously published. Among these may be mentioned a paper by Mr. J. Husband, concerning the slopers at Brentford, one of the works of the Brentford Gas Company, and of which Mr. Frank Morris is the Engineer. This paper was read before the Incorporated Institution of Gas Engineers, May 8th and 9th, 1895, and in it Mr. Husband said: "Now, after five years of operation, we are able to give *reliable* data concerning the working of the system." And he does not merely *say*, he *asserts*, that in their perfected form "slopers" "have proved great reducers of hard, wearisome toil, and great economizers of time, labor and capital." But the paper is so full of information on the subject that those desirous of it ought to read the original article.

In Germany the "slopers" have not as yet made much headway, mainly because of reasons which will presently be stated.

Herr W. von Oechelhaeuser, Director General of the German Continental Gas Company—who own a number of gas works—and whose home office is in Dessau, Germany, very kindly replied to an inquiry concerning the progress with the "slopers" in his country. He said that he had "Personally followed, *and on the spot*, the development of the inclined retorts, both in England and France; but although he felt greatly interested in the subject, still as the wages paid in Germany was not anything like as high as it was with us in America or in England, and as they never yet had *strikes*, the advantage economically considered, of the 'inclines,' appeared under these conditions unimportant. Hence he had not yet introduced the system at any of the works under his control."

The first bench (in Germany) was introduced at Stettin in 1890. The following year four sets of "inclines" were put up at the city works of Berlin. At Dresden two settings of the "inclines" were tried, and the first experience was so encouraging that an additional number of "slopers" had been erected since. Herr Hasse (Dresden) gave an account of results with the "inclines" at the meeting of the German Association of Gas Engineers, held at Cologne, in the summer of 1895, and he said that the producing capacity of the "slopers" was greater than that of the horizontals—per square foot of ground occupied—in the proportion of 5 : 4, and that the cost of manipulation was from one-third to one-half less for the "slopers."

"In consideration of the great importance of the question," wrote Herr v. Oechelhaeuser, "the German Association then elected a committee, who were to collect all information concerning the general experience with the system (inclines), and embody the same in a report to the Association at their next annual meeting (1896)." He also referred to the successful working of the "slopers" at Vienna. From Berlin, the Managing Director of the City Gas Works was so obliging as to send in a letter, dated April 21st, 1896, a comprehensive statement of results with his "slopers." They used elliptical retorts, Silesian coals, with four hour charges. The report as to number of ovens has been stated before. The coal used seems to yield 4.51 cubic feet of gas per pound—candle power not given. The retorts at Berlin are quite short, compared with those elsewhere. The Manager said that the results were not yet altogether satisfactory, insomuch that the furnace did not heat the retorts evenly, but that a new set had been erected in which the results are expected to be better.

We will now take up the well-authenticated results of the successful operation of the "slopers" at Vienna. On writing to Mr. Edward Drory, then Chief Engineer of the gas works "Erdberg," at Vienna (he has been promoted since to Berlin), that gentleman was pleased to send very full information on the subject of his experience with the "slopers." That plant is one of a number owned by that great English corporation, "The Imperial Continental Gas Association," of London. The information so generously sent came (though from Mr. Drory) through the principal office of the corporation just named, with full permission to publish and put it before this Association. The said Company is not in business to erect gas works for others, or to sell apparatus, and the sending of this information was, therefore, an act of disinterested kindness on the part of the officials of that Company, but particularly of Mr. Drory.

These gentlemen did not meet with success in their first trials with the "slopers," as will appear from Mr. Drory's letter, published herewith; but as they no doubt recognized the real practicability and advantage of that system of setting retorts, they were not discouraged, but eliminating the objectionable features as they found them, improved upon the original Coze plan step by step, and now for some years, as we are most credibly informed, have operated the "inclined retorts," or "slopers" with entire success, and no doubt to the considerable financial advantage of their corporation.

Permit me at this point to quote from a letter (by permission) of Mr. J. B. Crockett, written March 31st, 1896. He said: "I am very glad indeed to see you are going to take up the subject of inclined retorts once more. There is no question but that they are working them with great success at Vienna, and Mr. Edward Drory, the Superintendent (Chief Engineer), of the works there, told me that they were so well satisfied and pleased with them that they were going to add ten benches more to their plant. (Since added—*F. E.*)

"The ten benches in operation (Mr. Crockett was there in August) were working successfully, and seemed to be doing all that was claimed for them. I saw them draw the retorts, and they seemed to have no difficulty whatever either in getting the coke out or from the accumulation of any tar. They had a sort of plug at the lower mouthpiece to prevent the coal running over, and they charged from a platform at

NOTE BY THE AUTHOR.—It was found best, according to Mr. Herring, to charge all retorts from a certain height—a little over four feet above the bottom of the top end of the sloping retort—which may account for the three sets of charging buckets.—*F. E.*

the upper end of the bench, but in what I thought rather a crude way, and which could be improved upon very much, as they seemed to have three sets of buckets to take in the different lines of retorts, which I think could have been done with one just as easily. They had a track extending over the end of the bench for some distance, and upon charging the upper retort would push that bucket back over the end of the track and bring forward the second bucket to charge the middle retorts, then push that to the end of the track and introduce the third bucket for charging the lower retorts, all of which *seemed* a useless way of doing.

"They had an endless chain elevator which carried the coal from the sheds, dumped it into the hoppers at the end of the charging platform, from which it was discharged into the charging buckets. That part of the apparatus was very good indeed.

"The saving of labor is very evident, although they had no cellar to dump the coke into, but took it out from under the retorts in ordinary wheelbarrows. This could also be done to better advantage by having a cellar, and putting a conveyer in, taking the coke out through a water trough, and then to the storage bins. I have always believed with you, that the inclined retorts could be made a success, and after seeing them work at Vienna *I was more than satisfied with it.* Labor in Germany is cheap and plentiful, which accounts in a great measure their not adopting more labor-saving machinery, such as we have in this country." Thus far Mr. Crockett, and in connection with the last sentence, please remember what Herr von Oechelhaeuser said in his letter concerning the same subject, or condition of the labor question in Germany.

Under date of February 19th, 1896, Mr. Drory said: "The present satisfactory results I have only been able to obtain after three years of careful study and repeated improvements in the furnaces themselves and apparatus."

Mr. Drory then forwarded through the general office of his Company, at London, four sheets of drawings and a letter explaining same, together with some suggestions which are now before you, and which accompany this paper.

He said: "I have only to direct your attention to the principal merits of the system and to those points on which the success of a plant of 'slopers' depends."

1*st. Handling the Coal.*—"Have a simple and strong coal crusher, every moving part of which can be repaired or exchanged within a few hours, and an elevator and conveyer to suit. Have coal hoppers above and along the whole front of the furnaces, with a capacity of at least 24 hours, so you are safe against any small breakdown in the machinery. *I have not had one these four years.* And having the coal everywhere near at hand, you are able to charge the retorts with an unrivalled speed. This is the principal reason of our great economy in labor."

2d. *Construction of Retort House.*—"There is no expensive and large retort house and costly roof,[1] as necessary for horizontal retorts. You only want a very simple iron construction, in order to protect the furnaces against wind and rain, while all the work is to be done practically in the open air, which I have experienced to be a great advantage and comfort for the men. The retorts discharge the coke directly into the coke yard, no transport being necessary. In this way large economies are realized in cost and area of retort house, as well as in coke handling."

3d. *Construction of Furnace.*—"The furnace is a generator furnace of a new and simple design. The setting is light and yet strong, and enables you to produce high and uniform heats by a minimum consumption of fuel. It is easy to control and regulate. We have already produced 19,500 to 21,000 cubic feet of gas per retort and day (four hour duration of charges), the fuel having not exceeded 11 per cent. on coal carbonized. The retorts ought not to be much longer than 15 feet, otherwise the repair of small holes and cracks after the scurfing will be a difficult task."

(The latest installations in England, notably at Leeds, where, after a thorough previous investigation by the Corporation Gas Committee of other systems, the "slopers" were preferred, 28 settings of 7s, or 196 retorts, 20 feet x 24½ x 13 ⏢ were contracted for with the firm of Little & Graham, Limited. Hence there the longer retorts seem to be in favor.—*F. E.*)

"Upon the whole I feel entitled to regard my system of 'slopers' and retort house in its present development as a complete success. After eight years' of experience and continuous improvements I may safely recommend it to my fellow engineers as the cheapest and most efficient plant for the production of coal gas. Should you require any more information I would be glad to give it."

Since the quantities and values were given mostly on the metric system, and the old Austrian "Florins" and "Kreutzers," the writer has translated them, and in the translation some slight discrepancies of values may be found, which, however, do not materially affect the totals.

By consulting the tables you will observe how much lower workmen are paid in foreign countries than this. It may be that the purchasing power of money there is much greater than the same amount would be here, and as a matter of fact we know that this is so; but it will be well to remember at this time, and in connection with that portion of our subject, how often we meet the fellows who want to know why gas costs more here than in Europe. You have one of the reasons before you in the table of wages.

On table number 19 you will find a summary of the other 18 tables. The form is Mr. Drory's, and the writer found it so admirable that he has used it in connection with the presentation of the subject to you. The first six lines contain Mr. Drory's figures, only translated into "American." (Please note that the lines on table 19 correspond with the numbers of the tables containing details.) Lines 7, 8 and 9 contain facts and figures from my own experience, and with which the writer has been very familiar. Lines 10, 11 and 12 contain data concerning which a few explanations are necessary. In Mr. Drory's tables there are some figures relating to mechanical stoking. As we have no figures (at least not at date of writing this paper) showing at what cost "slopers" could be erected for now in this country, bearing in mind that the actual cost of these given, as put up in 1890 under the writer's supervision, was believed at that time to be too high, it was thought well to give a few facts about mechanical stoking.

General Andrew Hickenlooper kindly caused the Superintendent of Manufacture of his Company, Mr. W. S. Miller, to prepare and forward the information used in the preparation of the data mentioned as "From a Large American Gas Works," Tables 10, 11 and 12. Mr. Miller, after referring to the paper prepared by Mr. N. G. Kenan, and read at our Toronto meeting, gave full information upon all points asked for, and with aid of these replies the table concerning "A Large American Gas Works" was constructed. The writer does not know what the retort benches or retort house cost, but these figures were supplied from actual bids on like work, with which he is familiar. Please note this explanation for the cost of construction quoted under the headings just named may be greater or less than the actual cost was. The author then constructed a hypothetical retort house, put in the inclined retorts to produce the same amount of gas from the same kind of coal, using as factors Mr. Drory's results per retort, and his own experience as to labor required and cost of benches. The theoretical saving is shown on table No. 19, last column. The mechanical (steam) stoker requires a clear space of 16 feet between mouthpieces and wall of retort house, and as a labor-saver may be relied upon down to five benches in operation, as compared with hand stoking and with horizontal retorts. Much of the saving at the "Large American Gas Works" is due to the admirable arrangements for handling coal and coke mechanically, and to the employing of regenerator furnaces; and Mr. Drory's statements in connection with the "slopers" may be remembered at this point.

Table 13 gives the details as to actual cost and theoretical results (actual for a few days, however,) had our installation of "inclines" been successful. Tables and lines 14 and 15 give the hypothetical cost and results—for purposes of comparison merely—of gas made in England in "slopers" and horizontal retorts. The basis of the figures were obtained from the columns of the *Journal of Gas Lighting*, of London, at various times, and are only as near right as the author could make them with the data obtainable. They are not claimed to be absolutely correct, but only approximately so.

Lines 16, 17 and 18 contain a comparative statement of results obtained with coal gas, water gas, and what might have been expected, if "slopers" had been used to produce a like quantity of such gas at the same works. The cost of material has been omitted, because if you wish you can add that to suit your own locality.

Before leaving the subject of these tables permit me to again direct your attention to possible discrepancies in the first six tables. These tables were given in the old Austrian money of florins and kreutzers. Hence, in making the translations into American money, the author was careful to make *the items on each line as correct as possible*, going into detail as far as six places of decimals. But finding *then* that the additions of the columns would not always come right, and not knowing for certain which was the more correct, the lines or the footings, I

1. See engravings of photos of fine models of the Vienna Slopers, kindly loaned by Mr. E. Drory.

translated them as they were found, especially as the results were not affected to a serious degree, and were for comparative purposes anyhow, in the first place. But the reader will please take due notice of this necessary explanation in connection with the first six sheets or tables mentioned.

In conclusion the author would call your attention also to the following: One of the arguments in favor of water gas has ever been its very much greater independence, on account of manual labor. Now, the "slopers" are not as economical as water gas is on that account, but they do go a very long way towards cheapening the manufacture of gas in retorts, and thus make it quite possible to enrich uncarbureted water gas, made in the ordinary generator, by means of rich cannel gas made in sloping retorts, instead of using oil—if that be more economical. That such a method is practicable the writer has demonstrated to his own satisfaction, and he can safely assert that the mixture produced as fine an article of illuminating gas as he ever saw.

Having taken up the subject of "Inclined Retorts" where we left it at our Savannah meeting six years ago, I hope that the present effort to bring "Inclined Retorts up to Date" may meet with your approval.

Finally, the author desires to thank the gentlemen who were so kind as to respond to his application for information used in preparing this paper; and also to acknowledge his indebtedness to those from whose published writings extracts have been quoted, which have helped not a little to the better understanding of the subject.

As all but two of the contributors included in the above have been named in the text of the paper, the pleasant duty of mentioning the remaining ones may be permitted here: They are Mr. Emerson McMillin, who, as President of the Laclede Gas Light Company, of St. Louis, Mo., materially aided in the experimental research in the practical field with inclined retorts; and the Secretary of our Association, who contributed largely by the loan of his books, and no less by the care bestowed on the publication, to whatever measure of success may be attained by this paper.

TABLE NO. 1.—INCLINED RETORTS OR "SLOPERS."—System "Drory."

10 Cozé furnaces, 9 retorts each; retorts 15 feet long.
Production of gas per retort and day, 17,657 cubic feet.
Fuel required, 12 per cent. on coal carbonized.
Area of retort house, 5,274.36 square feet.
Daily production per square foot of area, 301 cubic feet.
Daily production per lineal foot of retort in fire, 1,302 cubic feet.

Cost of Construction.

Retort house	$12,249.15
10 benches, or "furnaces," at $5,787 each	57,870.00
Coal breakers, steam engines and elevators, being half the cost of existing plant, this being enough for 20 benches	3,809.77
Total cost of construction	$73,928.92

Cost of Manipulation.

4 stage men, at $1.44675	$5.78
6 ground floor men, at $1.01272	6.07
6 coke quenchers, at $1.01272	6.07
1 fireman, at $1.44675	1.44
2 foremen, at $1.44675	2.89
Cost per 24 hours	$22.27
Cost for 200 working days	$4,455.97
Five per cent. interest on cost of construction	3,696.44
Wear and tear of charging and discharging apparatus	482.25
Wear and tear of other stoker tools	1,668.58
Total cost of manipulation	$10,303.25

TABLE NO. 2.—INCLINED RETORTS OR "SLOPERS."—System "Drory."

14 Cozé furnaces or benches, 9 retorts each; retorts 12 feet long.
Production of gas per retort and day, 12,612 cubic feet.
Fuel required, 12 per cent. on coal carbonized.
Area of retort house, 9,967.46 square feet.
Daily production per square foot, 159 cubic feet.
Daily production per lineal foot of retort in fire, 1,344 cubic feet.

Cost of Construction.

Retort house	$14,467.50
14 furnaces complete, at $5,063.62½	70,890.75
Coal breaker, elevator, steam engine, etc	3,809.77
Total cost of construction	$89,168.02

Cost of Manipulation.

6 stage men, at $1.44675	$8.68
6 floor men, at $1.01272	6.07
6 coke wheelers, at $1.01272	6.07
6 coke quenchers, at $1.01272	6.07
1.5 firemen, at $1.44675	2.17
2 foremen, at $1.44675	2.89
Cost per 24 hours	$31.97
Cost for 200 working days	$6,394.63
Five per cent. interest on cost of construction	4,458.40
Wear and tear of charging and discharging tools	675.15
Wear and tear of other stoker tools	2,336.01
Total cost of manipulation	$13,864.20

TABLE NO. 3.—HYDRAULIC STOKERS.

22 Hasse-Didier furnaces (generators), 9 retorts each; retorts 9 feet 6 inches long.
Production of gas per retort and day, 8,027 cubic feet (dif., 257).
Fuel required, 12 per cent. on coal carbonized.
Area of retort house, 18,686 square feet.
Daily production of gas per square foot, 85 cubic feet.
Daily production per lineal foot of retort in fire, 891.7 cubic feet.

Cost of Construction.

Retort house	$28,935.00
22 furnaces, at $3,858	84,876.00
Hydraulic stokers, coal hoppers, etc	29,513.70
Total cost of construction	$143,324.70

Cost of Manipulation.

8 machine men, at $1.205625	$9.64
10 helpers, at $1.01272	10.12
10 coke wheelers, at $1.01272	10.12
6 quenchers, at $1.01272	6.07
2 firemen, at $1.44675	2.89
2 foremen, at $1.44675	2.89
2 locksmiths, at $1.109175	2.21
2 boilermen, at $0.9645	1.92
2 engine drivers, at $1.3503	2.70
Extra fuel	7.95
Cost per 24 hours	$56.56
Cost for 200 working days	$11,313.55
Five per cent. interest on cost of construction	7,166.23
Wear and tear of charging apparatus	1,379.23
Wear and tear of other stoker tools	3,670.00
Total cost of manipulation	$23,529.91

TABLE NO. 4.—HYDRAULIC STOKERS.

28 ordinary fire-bar furnaces, 7 retorts each; retorts 9 feet 6 inches long.
Production of gas per retort and day, 8,107 cubic feet.
Fuel required, 18 per cent on coal carbonized.
Area of retort house, 18,029 square feet.
Daily production per square foot of retort house area, 88 cubic feet.
Daily production per lineal foot of retort in fire, 900 cubic feet.

Cost of Construction.

Retort house	$22,183.50
28 furnaces, at $1,929	54,012.00
Hydraulic stokers complete	37,567.27
Total cost of construction	$113,762.77

Cost of Manipulation.

8 machine men, at $1.205625	$9.64
10 helpers, at $1.01272	10.12
10 coke wheelers, at $1.01272	10.12
6 quenchers, at $1.01272	6.07
14 firemen, at $1.44675	20.25
2 foremen, at $1.44675	2.89
2 machinists or locksmiths, at $1.109175	2.21
2 boilermen, at $0.96450	1.92
2 engine drivers, at $1.3503	2.70
Extra fuel for machines	7.95
Cost per 24 hours	$73.91

Cost for 200 working days	$14,783.95
Five per cent. interest on cost of construction	5,688.13
Extra fuel for benches	10,609.50
Wear and tear of apparatus	1,929.00
Wear and tear of other stoker tools	4,672.03
Total cost of manipulation	$37,682.63

TABLE NO. 5.—MANUAL LABOR.

22 Hasse-Didier generator furnaces, 9 retorts each; retorts 9 feet 6 inches long.
Production of gas per retort and day, 8,026 cubic feet (dif. 257 cubic feet).
Fuel required, 12 per cent. on coal carbonized.
Area of retort house, 18,686 square feet.
Daily production of gas per square foot, 85 cubic feet.
Daily production per lineal foot of retort in fire, 891.7 cubic feet.

Cost of Construction.

Retort house	$28,935.00
22 furnaces, at $3,858	84,876.00
Total cost of construction	$113,811.00

Cost of Manipulation.

44 stokers, at $1.44675	$63.65
2 firemen, at $1.44675	2.89
2 foremen, at $1.44675	2.89
6 coke quenchers, at $1.01272	6.07
Cost per 24 hours	$75.52
Cost for 200 working days	$15,104.06
Five per cent. interest on cost of construction	5,690.55
Wear and tear of charging and discharging apparatus	3,086.40
Wear and tear of other stoker tools	3,670.88
Total cost of manipulation	$27,551.90

TABLE NO. 6.—MANUAL LABOR.

28 ordinary firebar furnaces, 7 retorts each; retorts 9 feet 6 inches long.
Production of gas per retort and day, 8,107 cubic feet (about).
Fuel required, 18 per cent. on coal carbonized.
Area of retort house, 18,029.7 square feet.
Daily production of gas per square foot, 88 cubic feet.
Daily production of gas per lineal foot of retort in fire, 900 cubic feet.

Cost of Construction.

Retort house	$22,183.50
28 furnaces, at $1,929 complete	54,012.00
Total cost of construction	$76,195.50

Cost of Manipulation.

56 stokers, at $1.44675	$81.01
2 foremen, at $1.44675	2.89
6 coke quenchers, at $1.01372	6.07
Cost per 24 hours	$89.98
Cost for 200 working days	$17,997.57
Five per cent. on cost of construction	3,809.77
Extra fuel for furnaces	10,609.50
Wear and tear of charging and discharging apparatus	4,320.96
Wear and tear of other stoker tools	4,672.03
Total cost of manipulation	$41,409.84

TABLE NO. 7.—MANUAL LABOR.—(A Western Gas Works.)

50 ordinary firebar furnaces, 3 retorts each; retorts 9 feet 3 inches × 27 inches × 15 inches inside measurement.
Production of gas per retort and day, 9,820 cubic feet.
Fuel required, 22.2 per cent. on coal carbonized.
Area of retort house, 13,216 square feet.
Daily production of gas per square foot, 111 cubic feet.
Daily production per lineal foot of retort in fire, 1,091 cubic feet.

Cost (estimated) of Construction.

50 furnaces, at $708	$35,400.00
Ground floor retort house, complete	19,238.00
Total cost of construction	$54,638.00

Cost of Manipulation.

2 foremen, at $3.50	$7.00
50 stokers, at $3	150.00
8 coal men, at $2	16.00
4 lid men, at $2	8.00
Keep of 6 mules to haul coal, at 50 cents	3.00
Cost per 24 hours	$184.00
Cost of 200 days	$36,800.00
Six per cent. interest on cost of construction	3,278.28
Wear and tear of stokers' tools and apparatus	8,838.00
Wear and tear on benches and buildings	6,650.00
Total cost of manipulation	$55,566.28
Cost per ton of coal	$2.074
Cost per 1,000 cubic feet	0.1886

TABLE NO. 8.—MANUAL LABOR.—(A Western Gas Works)

20 ordinary firebar furnaces, 5 retorts each; retorts 8 feet 3 inches × 22 inches × 13 inches inside measurement.
Production of gas per retort and day, 8,107 cubic feet.
Fuel required, 22 per cent. on coal carbonized
Area of retort house, 6,000 square feet.
Daily production per square foot, 135 cubic feet.
Daily production per lineal foot of retort in fire, 1,013 cubic feet.

Cost of Construction.

20 furnaces, at $1,037, complete	$20,740.00
Stage floor retort house, complete	15,600.00
Total cost of construction	$36,340.00

Cost of Manipulation.

2 foremen, at $3.50	$7.00
20 stokers, at $2.75	55.00
10 helpers, at $2.25	22.50
6 coal men, at $2.25	13.50
4 coke men, at $2	8.00
2 lid men, or luters, at $1.75	3.50
Cost per 24 hours	$109.50
Cost for 200 days	$21,900.00
Six per cent. interest on cost of construction	2,180.40
Wear and tear of stokers' tools and apparatus	4,864.20
Wear and tear on benches and buildings	2,700.00
Total cost of manipulation	$31,644.60
Cost per ton of coal	$2.22
Cost per 1,000 cubic feet	0.1951

TABLE NO. 9.—MANUAL LABOR.—(A Western Gas Works.)

8 ordinary firebar furnaces, 6 retorts each; retorts 8 feet 3 inches × 22 inches × 13 inches inside measurement.
Production of gas per retort and day, 8,107 cubic feet.
Fuel required, 18.5 per cent. on coal carbonized.
Area of retort house, 2,400 square feet.
Daily production per square foot, 162 cubic feet.
Daily production per lineal foot of retort in fire, 1,013 cubic feet.

Cost of Construction.

8 furnaces complete, at $1,245	$9,960.00
Stage floor retort house, complete	6,400.00
Total cost of construction	$16,360.00

Cost of Manipulation.

2 foremen, at $3	6.00
8 firemen, at $2.75	22.00
4 helpers, at $2.25	9.00
2 coal men, at $2	4.00
2 coke men, at $2	4.00
2 luters, or lid men, at $2	4.00
Cost per 24 hours	$49.00
Cost for 200 days	$9,800.00
Six per cent. interest on cost of construction	981.60
Wear and tear of stokers' tools and apparatus	2,334.81
Wear and tear on benches and buildings	1,400.00
Total cost of manipulation	$14,516.41
Cost per ton of coal	$2.1303
Cost per 1,000 cubic feet	0.1865

TABLE No. 10.—STEAM STOKING.—(A Large American Gas Works.)

56 regenerator furnaces, 8 retorts each; retorts 9 feet 6 inches × 16 inches × 25 inches inside measurement.
Production of gas per retort and day, 7,777.44 cubic feet.
Fuel required, 15.5 per cent. on coal carbonized.
Area of retort house, 21,228 square feet.
Daily production per square foot, 164+ cubic feet.
Daily production per lineal foot of retort in fire, 864 cubic feet.

Cost (partly estimated) of Construction.

56 regenerator furnaces, at $3,150, complete	$176,400.00
Stage floor retort house	57,560.00
Steam stoker and chargers, including one spare machine	33,000.00
Coal hoppers and machinery	14,000.00
Total cost of construction	$280,960.00

Cost (partly estimated) of Manipulation.

2 foremen, at $3.25	$6.50
12 machine men, average at $2.75	33.00
28 lid men	56.00
4 furnace men, at $1.50	6.00
12 coke men, at $1.50	18.00
16 coal men, at $1.50	24.00
Cost per 24 hours, without fuel and oil for machines	$143.50
Cost for 200 working days	$28,700.00
Six per cent. interest on cost of construction	16,857.60
Fuel and oil for stokers and chargers	3,000.00
Wear and tear of machinery	2,080.00
Wear and tear of all other apparatus, benches, etc	18,791.20
Total cost of manipulation	$69,428.60
Cost per ton of coal	$1.0073
Cost per 1,000 cubic feet	.0915

TABLE No. 11.—MANUAL LABOR.—(Same Works as No. 10.)

56 generator furnaces, 8 retorts each; retorts 9 feet 6 inches × 16 inches × 25 inches inside measurement.
Production of gas per retort and day, 7,777.44 cubic feet.
Fuel required, 15.5 per cent. on coal carbonized.
Area of retort house, 21,228 square feet.
Daily production per square foot, 164 + cubic feet.

Cost (partly estimated) of Construction.

56 regenerator furnaces, at $3,150, complete	$176,400.00
Stage floor retort house, complete	57,560.00
Total cost of construction	$233.960.00

Cost (partly estimated) of Manipulation.

2 foremen, at $3	$6.00
84 stokers, at $2.50	210.00
28 helpers, at $2.25	63.00
20 coal men, at $2	40.00
2 weighers, at $1.50	3.00
4 furnace men, at $1.50	6.00
12 coke men, at $1.50	18.00
Cost per 24 hours	$346.00
Cost for 200 working days	$69,200.00
Six per cent. interest on cost of construction	14,037.00
Wear and tear on apparatus, including benches and building	18,791.00
Wear and tear on other stokers' tools	1,600.00
Total cost of manipulation	$103,628.00
Cost per ton of coal	$1.5036
Cost per 1,000 cubic feet	.1367
Annual saving of stoker over manual labor	$34,199.20

TABLE No. 12.—HYPOTHETICAL SLOPERS VS. THE STEAM STOKER, AT A LARGE AMERICAN GAS WORKS.—(Same as for Tables Nos. 10 and 11.)

22 Drory furnaces, 9 retorts each; retorts 15 feet long.
Production of gas per day and retort, 19,141 + cubic feet.
Fuel required, 12 per cent. on coal carbonized.
Area of retort house occupied, 15,370 square feet.
Daily production of gas per square foot, 246.5 cubic feet.
Daily production per lineal foot of retort in fire (14 feet), 1,367 cubic feet.

Estimated Cost of Construction.

22 furnaces, at $4,858.52 (a high figure)	$106,887.44
Retort house as before (occupied and not occupied)	57,560.00
Coal hoppers and machinery	7,700.00
Total cost of construction	$172,147.44

Estimated Cost of Manipulation.

2 foremen, at $3.75[1]	$7.50
10 stage men, at $2	20.00
10 floor men, at $2	20.00
6 coke men, at $1.50	9.00
8 coal men, at $1.50	12 00
Cost per 24 hours	$68.50
Annual cost, or cost for 200 days	$13,700.00
Six per cent. interest on cost of construction	10,328.64
Wear and tear of benches	15,556.86
Wear and tear of other tools and apparatus	2,000.00
Total cost of manipulation	$41,585.50
Cost per ton of coal	$0.6033
Cost per 1,000 cubic feet	0.0548
Annual saving over steam stoker	$27,843.30
Annual saving over manual labor	62,042.50

TABLE No. 13.—COZE SYSTEM, INCLINED RETORTS, IN 1890.—(Trial at a Western Gas Works.)

8 Cozé-Arndt furnaces, 7 retorts each; retorts 10 feet 10½ inches long.
Production of gas per retort and day (a few days only), 11,784 cubic feet.
Fuel required, 12 per cent. on coal carbonized (20 per cent. of coke made).
Area of retort house, 3,016 square feet.
Daily production per square foot, 218.8 cubic feet (while working).
Daily production per lineal foot of retort in fire, 1,372.9 cubic feet.

Cost of Construction.

8 Coze-Arndt furnaces, at $3,797.25	$30,378.00
Stage floor retort house, complete	7,496.00
Coal hoppers, wagonettes, elevator and engine	3,000.00
Total cost of construction	$40,874.00

Cost of Manipulation (experimentally).

2 foremen, at $3	$6.00
4 chargers, at $2.25	9.00
4 dischargers, at $2.25	9.00
4 coal men, at $1.85	7.40
2 men on top with charging chute and lids, at $2	4.00
2 furnace men, at $2.75	5.50
2 coke men, at $1.75	3.50
Cost per 24 hours (a few days only)	$44.40
Cost for 200 working days would have been	$8,880.00
Six per cent. interest on cost of construction	2,452.44
Wear and tear of benches (estimated)	3,226.80
Wear and tear of other tools and apparatus (estimated)	700.92
Estimated cost of operation had all gone well	$15,260.16
Cost per ton of coal	$1.2716
Cost per 1,000 cubic feet	.1156

TABLE No. 14.—Hypothetical Gas Works in England, with the "Sloper" System.

[Compiled from data found occasionally in the columns of the *Journal of Gas Lighting*, of London, England.]

8 benches of 7 retorts each; retorts 20 feet × 24½ inches × 13 inches, "D's."
Production of gas per retort and day, 16,167 cubic feet.
Fuel, as per coke sold, 8 per cent. on coal carbonized.

Cost of Construction.

8 regenerator furnaces, with 7 retorts, at $2,760.10	$22,080.80
Retort house	4,416.16
Coal hopper and elevator	1,600,00
Total cost of construction	$28,096.96

1. In English works with "slopers" the leading men receive more wages than when working with horizontals; hence that course was adopted in this hypothetical case.

Cost of Manipulation.

2 men, at $1.57	$3.14
8 men, at $1.34	10.72
2 firemen, at $1.46	2.92
2 boys, at $0.73	1.46
2 pipe jumpers, at $1.40	2.80
Cost per 24 hours	$21.04
Cost per annum	$4,208.00
Five per cent. interest on cost of construction	1,404.84
Wear and tear of furnaces (10 per cent. on cost)	2,208.08
Wear and tear of other tools and apparatus	248.32
Total cost of manipulation	$8,089.24

or 4 15 cents per 1,000 to outlet from retort house, on account of cost of manipulation.

TABLE NO. 15.—MANUAL LABOR.—Hypothetical Coal Gas Works in England, with Horizontal Retorts.

[Compiled from data found occasionally in the columns of the *Journal of Gas Lighting*, of London, England.]

20 regenerator furnaces, 7 retorts each; retorts 9 feet × 24½ inches × 13 inches; "D's."
Production of gas per retort and day (including "scurfers") 6,466.8 cubic feet.
Fuel required, as per coke sold, 12 per cent. on coal carbonized.

Cost of Construction.

20 regenerator furnaces with 7 retorts, at $1,289.99	$25,699.80
Retort house	8,566.60
Total cost of construction	$34,266.40

Cost of Manipulation.

8 scoop drivers, at $1.30	$10.40
16 stokers, at $1.30	20.80
4 firemen, at $1.35	5.40
2 "pokers-in," at $1.07	2.14
2 breeze boys, at $0.73	1.46
2 coal trimmers, at $1.07	2.14
2 pipe jumpers, at $1.30	2.60
4 "fire-makers," at $1.07	4.28
Cost per 24 hours	$49.22
Cost per annum	$9,844.00
Five per cent. interest on cost of construction	1,284.99
Wear and tear of furnaces, at 10 per cent	2,569.98
Wear and tear of other tools and apparatus	250.00
Four per cent. more fuel required than with slopers, not estimated	....
Total cost of manipulation (with above exception)	$13,948.97

or, on account of manipulation only, 7.69 cents per 1,000 cubic feet to outlet from retort house.

TABLE NO. 16.—MANUAL LABOR.

NOTE.—The year's "sendout" corresponds to 200 times (nearly) the maximum (ordinary) 24 hours' make in December. The maximum 24 hours' make is assumed to be 348,000 cubic feet—the coal yielding, with 10 per cent. Bear Creek cannel and 90 per cent. caking coals, 4.80 cubic feet of 22-candle power gas sold.

12 firebar furnaces, 5 retorts each; retorts 8 feet 3 inches × 21 inches × 13 inches; "D's." This includes retorts for scurfers.
Production per retort in action (day), 6,000 cubic feet.
Fuel required, 26 per cent. on coal carbonized.
Area of retort house, 4,536 square feet.
Daily production of gas per square foot, 76.7 cubic feet.
Daily production per lineal foot of retort in fire, 774.3 cubic feet.

Cost of Construction.

12 firebar ground floor benches of 5's, at $750	$9,000.00
Ground floor retort house	4,200.00
Total cost of construction	$13,200.00

Cost of Manipulation.

6 stokers, at $2.25	$13.50
6 stokers, at $2	12.00
6 helpers and coal men, at $1.75	10.50
6 yardmen, at $1.50	9.00
2 foremen, at $2.50	5.00
Cost per 24 hours	$50.00
Cost per annum	$10,000.00
Six per cent. interest on cost of construction	792.00
Wear and tear of retorts and tools	1,400.00
Extra fuel (excess over such used by better furnaces at $3 per ton for coke)	2,742.00
Total cost of manipulation	$14,934.00
Cost per ton of coal carbonized	$2.30
Cost per 1,000 cubic feet	0.2456

This is to outlet of retort house only, and does not include scrubbing, condensing, exhauster, purification, superintendence, etc., and neither does it include gas making material, as was explained in the text of the paper. Note that by using modern furnaces the saving in the same settings would be 4 cents (nearly) per 1,000 for coke alone at the price given, which in this case is taken lower than the real value.

TABLE NO. 17.—WATER GAS.—The production per day and year as per Table No. 16.

Cost of Construction.

Retort house (portion of the house occupied by the retort benches in previous table)	$3,000.00
Lowe (improved) apparatus complete	10,500.00
Foundations for same (concrete)	350.00
Boiler, feed pumps, oil tank and pump, etc	2,000.00
Total cost of installation	$15,860 00

Cost of Manipulation.

1 foreman gas maker, at $3	$3.00
1 gas maker, at $2.50	2.50
2 gas maker's helpers (one on each shift), at $2	4.00
1 day laborer, at $1.50	1.50
Cost per 24 hours	$11.00
Cost per annum	$2,200.00
Six per cent. interest on cost of construction	951.00
Wear and tear of apparatus and tools	700.00
Total cost of manipulation	$3,851.00

Cost per 1,000, $0.553 for manipulation only, to inlet of exhauster.

The exceptions noted on Table No. 16 apply here also; furthermore, let it not be overlooked that the cost of material with water gas is very much greater, in some instances, double, what it cost for coal gas. At larger works the cost should be less, at smaller ones more.

TABLE NO. 18.—COAL GAS.

Conditions as to cost of material and gas required, the same as per Tables No. 16 and 17, but estimated to be manufactured by retorts set on the inclined or "sloper" system; and labor required, as to number of men, according to the facts as given by Mr. Drory and others.

Cost of Construction.

3 "Drory" benches of six 15-foot retorts, at $3,274	$9,822.00
Portion of retort house occupied, as before	3,000.00
Coal handling apparatus and hoppers	1,200.00
Total cost of construction	$14,022.00

Cost of Manipulation.

2 gas makers, at $2.75	$5.50
4 helpers, at $2	8.00
6 yardmen, at $1.75	10.50
Cost per 24 hours	$24.00
Cost per annum	$4,800.00
Six per cent. interest on cost of construction	841.32
Wear and tear of benches, at 10 per cent	982.20
Wear and tear on tools and other apparatus	300.00
Total cost of manipulation	$6,923.52
Cost per ton of coal carbonized	$1.06
Cost per 1,000 cubic feet	0.0994

Let it be assumed that the net cost of material per 1,000 cubic feet of coal gas is 22 cents, and for water gas 30 cents, which is the case in some instances.

The cost per 1,000 for coal gas made the old way would be 46 cents, for water gas 35.53 cents, and for coal gas made in the "slopers," or perhaps by means of stoking machinery, 31.94 cents to inlet of exhauster, which, of course, excludes all cost under the head of scrubbing, condensing, purification, superintendence, etc.

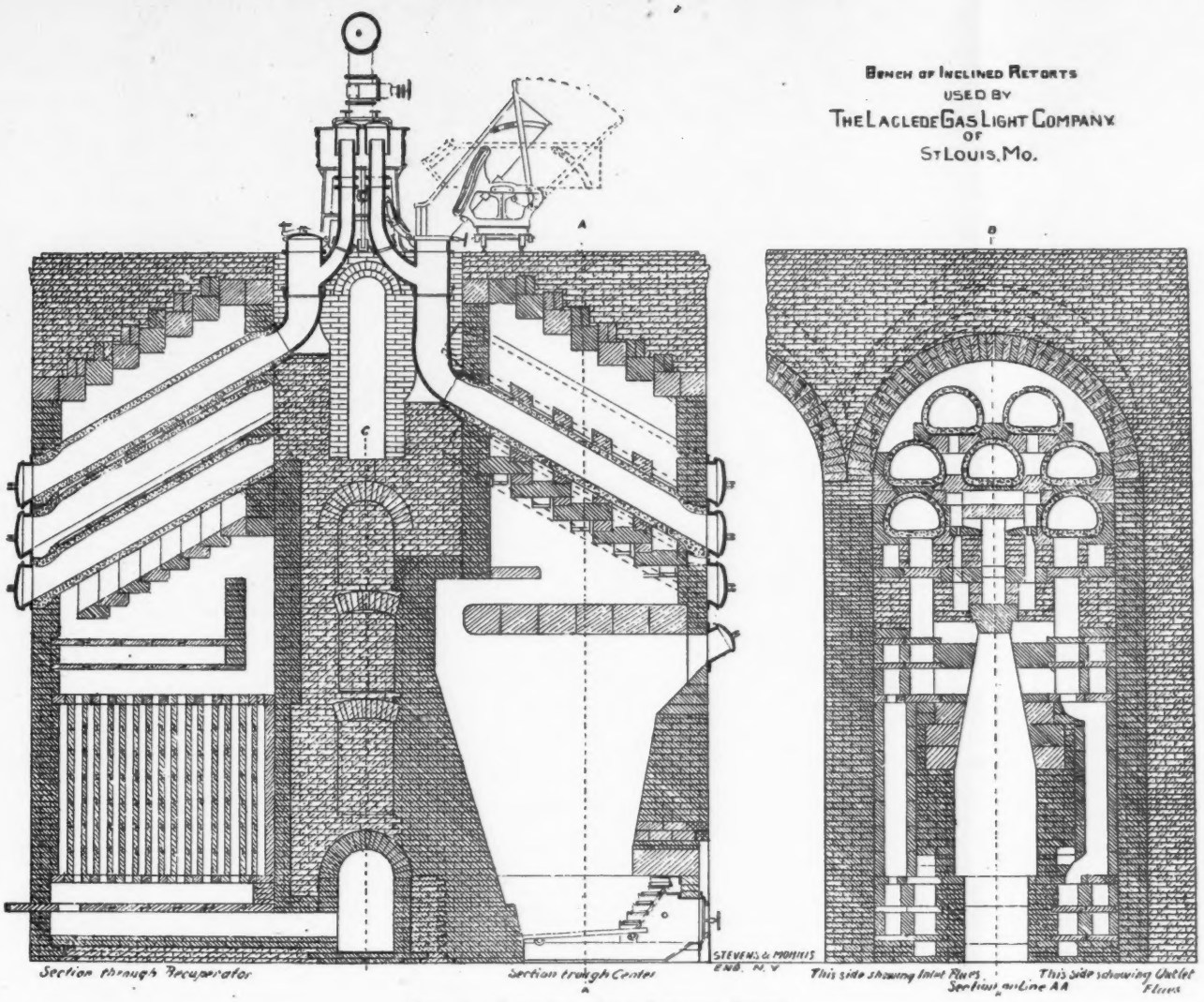
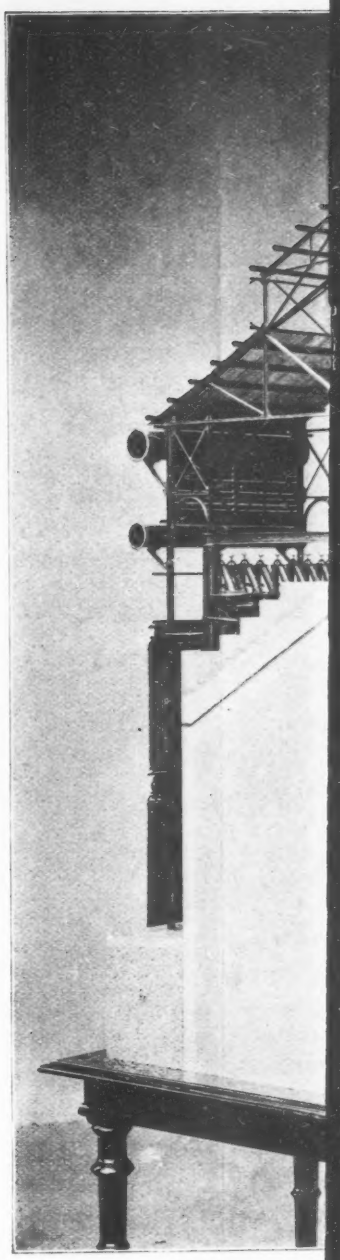


Fig. A. Laclede Cozé Retort Bench.



Retort H

Edward Drory's

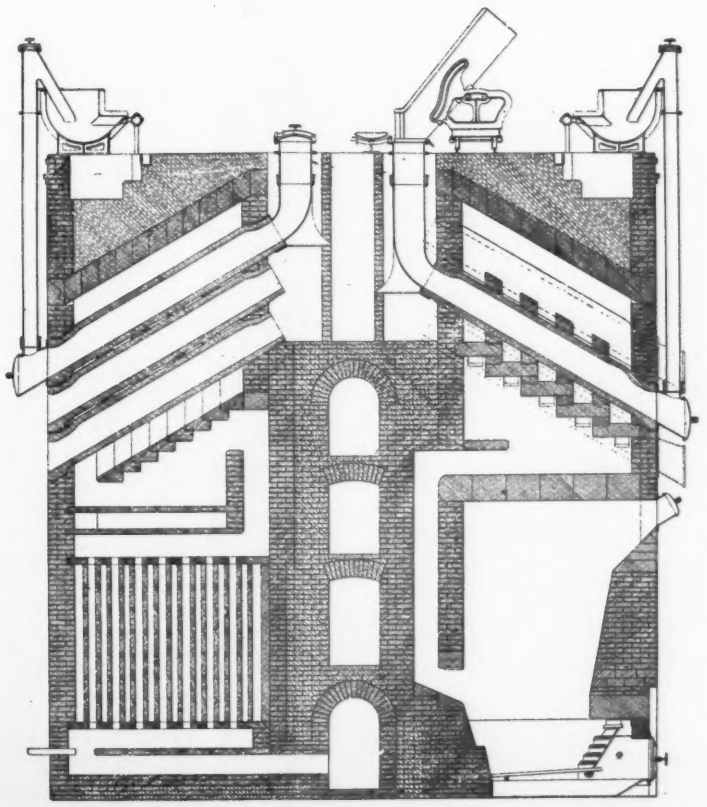
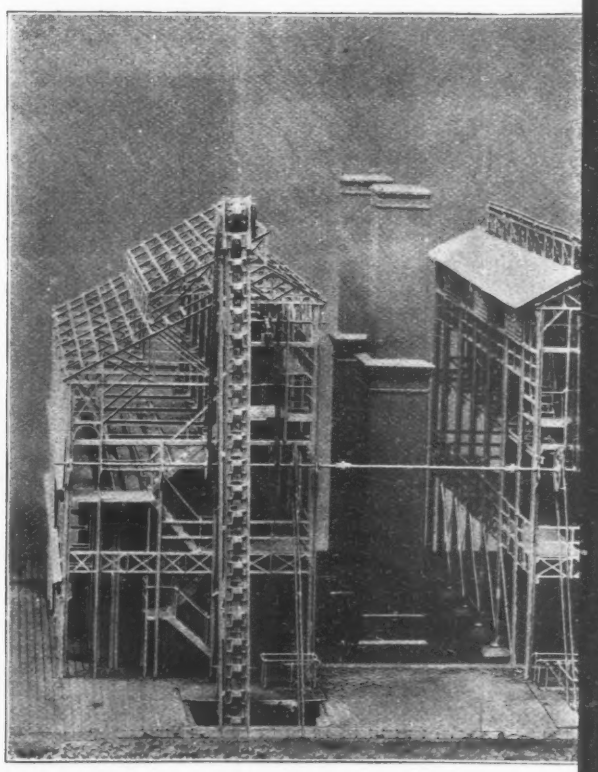
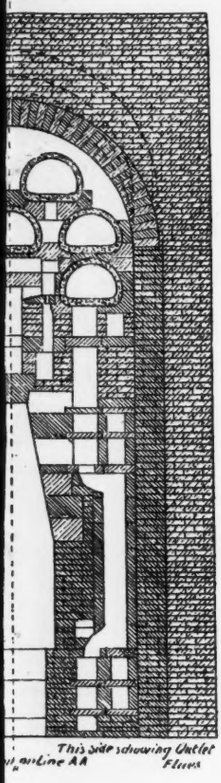


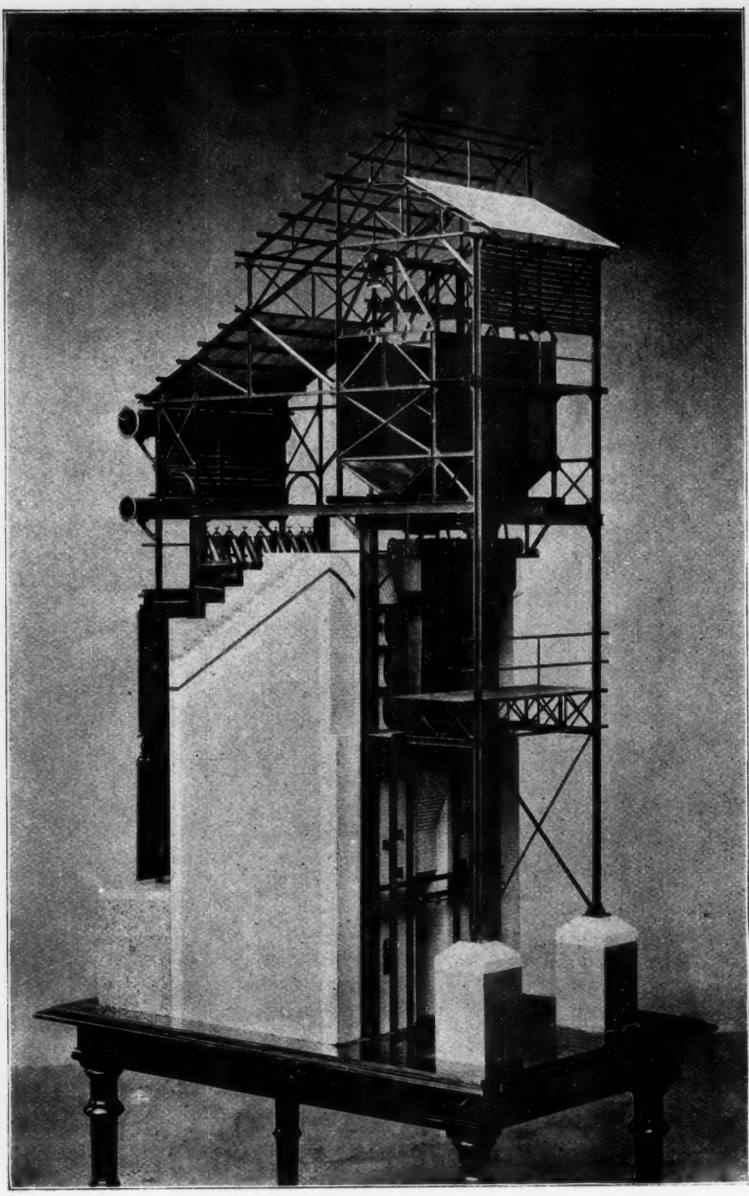
Fig. B. Cozé Retort Bench.



Retort House for Cozé Furna

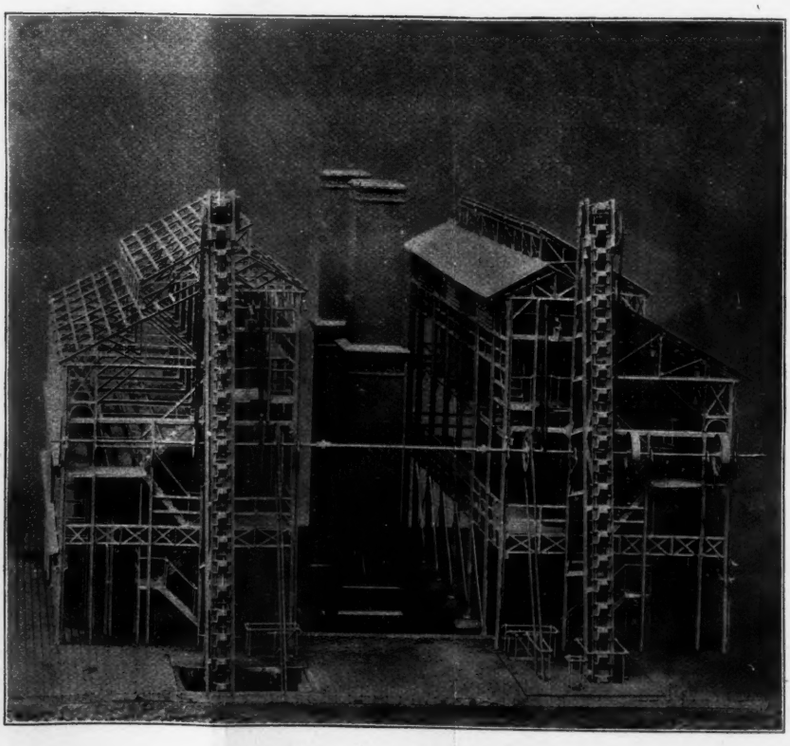
Edward Drory's System, I. C. G. A. Vien





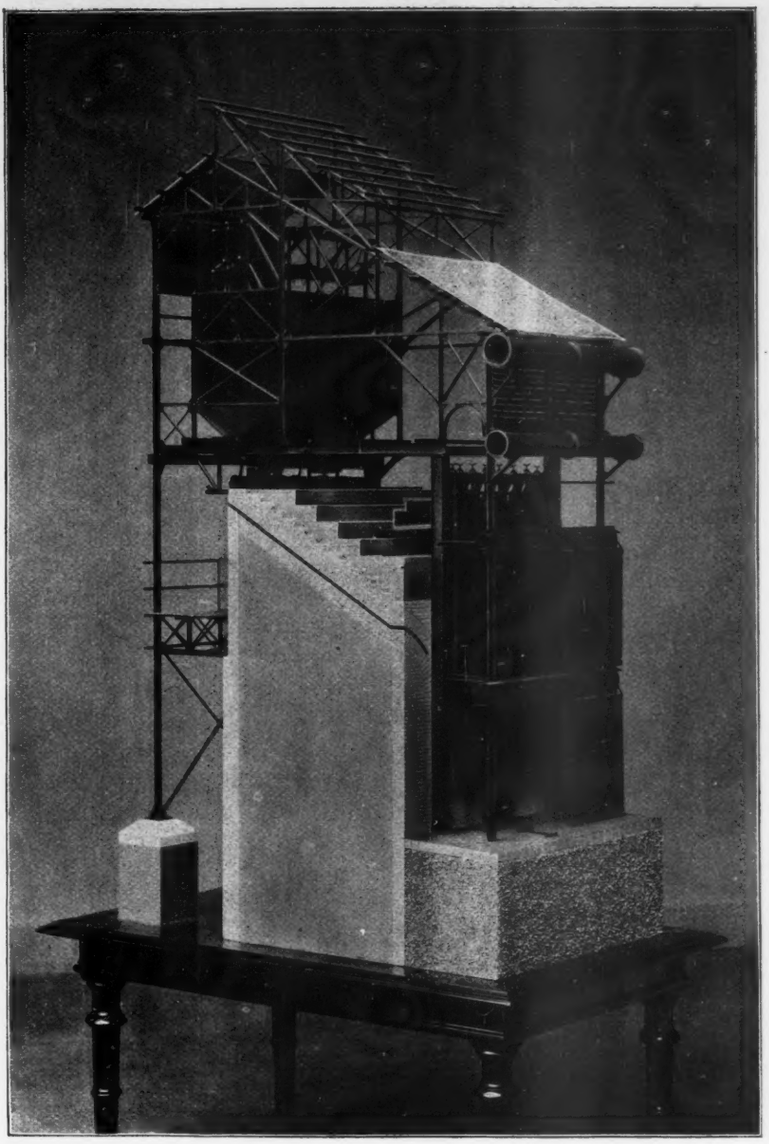
RETORT HOUSE FOR COZÉ FURNACES.

Edward Drory's System, I. C. G. A., Vienna, 1891.



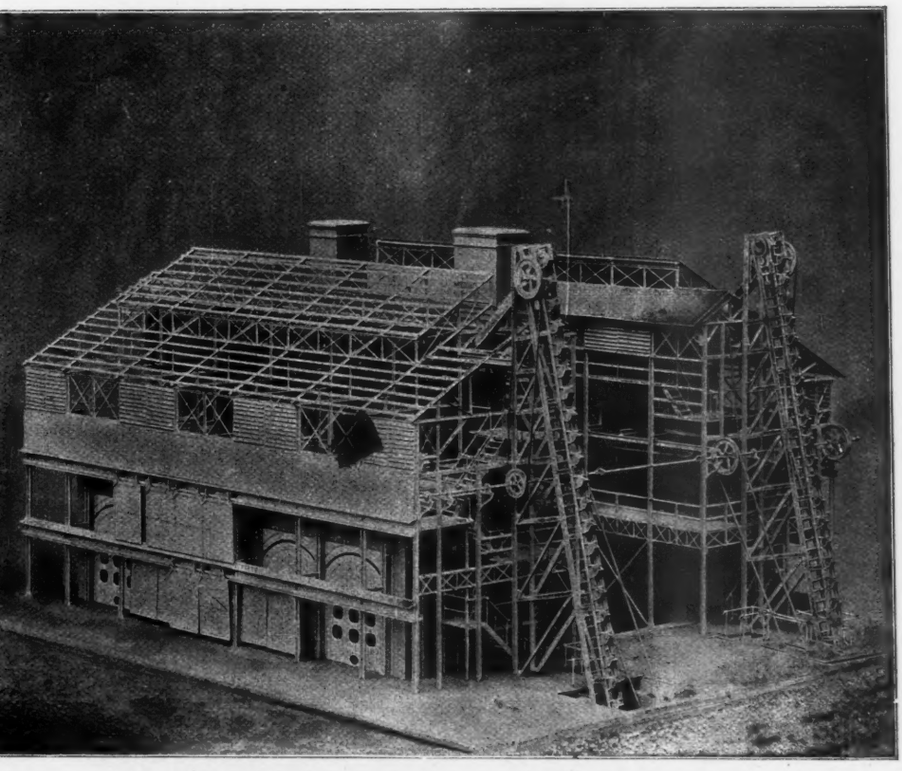
RETORT HOUSE FOR COZÉ FURNACES.

Edward Drory's System, I. C. G. A. Vienna, 1891.



RETORT HOUSE FOR COZÉ FURNACES.

Edward Drory's System, I. C. G. A., Vienna, 1891.



RETORT HOUSE FOR COZÉ FURNACES.

Edward Drory's System, I. C. G. A., Vienna, 1891.

TABLE No. 19.

[Arranged after a form from Mr. Edward Drory, Chief Engineer at the Imperial Continental Gas Association's Works at Vienna, Austria.*—F. E.]

SUMMARY OF TABLES No. 1 TO 18,
COMPILED BY
FREDERICK EGNER, GAS ENGINEER,
FOR
"THE AMERICAN GAS LIGHT ASSOCIATION."
May 7th, 1896. Norfolk, Virginia.

Number of Table.	Method of Operation.	COMPARATIVE COST OF CONSTRUCTION. Number of Retorts Set.	Dimensions of Retorts.	Approximate Daily Capacity of Retort.	Capital Outlay per Retort Set.	Capital Outlay per 1000 Cubic Feet Retort Capacity.	COMPARATIVE COST OF MANIPULATION. Average Total Capacity of Plant per annum, or 300 maximum working days.	Per cents. of Fuel reckoned as coal carbonized.	Total Annual Cost of Manipulation to outlet of retort house, exclusive of water, taxes, ground rent and superintendence.	Cost per 1000 cubic feet for Manipulation only, with exceptions as per previous column.	Total Economy shown by the use of "Slopers."
			Length.	Cubic Feet.			Cubic Feet.				
1	Slopers.....	10 Existing "Drory" furnaces.....	90	15'	17,657	$821 27	$46 51	317,826,000	12 0	$10,303 27	3 24 cents.	.....
2	Slopers.....	14 Existing "Drory" furnaces.....	126	12'	12,612	707 46	56 09	About the same.	12.0	13,864 20	4 36 "	$3,560 93 No. 1 over No. 2.
3	Hydraulic Stokers	22 Hasse-Didier furnaces. (Existing).....	198	9' 6"	8,026	723 85	90 18	" "	12 0	23,529 94	7.40 "	$13,226 67
4	Hydraulic Stokers	28 Fire-bar furnaces. (Existing).....	196	9' 6"	8,107	589 62	71 61	" "	18 0	37,684 46	11.85 "	$27,381 19
5	Manual Labor.....	22 Hasse-Didier furnaces. (Existing)	198	9' 6"	8,026	574 84	71 62	" "	12.0	27,590 90	8.68 "	$17,287 63
6	Manual Labor.....	28 Fire-bar furnaces. (Existing).....	196	9' 6"	8,107	388 69	47 94	" "	18.0	41,409 84	13.02 "	$31,106 57
7	Manual Labor..... (Western Gas Works.)	50 Fire-bar furnaces, 3 retorts each. Ground floor. (Existing).. (One part of works only quoted.—F.E.)	150	9' 6"	9,820	364 25	37 09	294,000,000	22.2	55,566 28	18.86 "	$21,505 80 Comp'd with No. 13.
8	Manual Labor..... (Western Gas Works.)	20 Fire-bar furnaces, 5 retorts each. Stage floor. (Existing)..	100	8' 6"	8,107	363 40	44 82	162,140,000	22.0	31,644 60	19.5 "	$13,003 62 Comp'd with No. 13.
9	Manual Labor..... ..... (Western Gas Works.)	8 Fire-bar furnaces, 6 retorts each. Stage floor	48	8' 6"	8,107	340 83	42 04	77,827,200	18 5	14,516 41	18.65 "	$5,575 93 Comp'd with No. 13.
10	Steam Stoker..... (A Large Am. Gas Works.)	56 Regenerator furnaces, 8 retorts each. Stage floor.....	448	9' 6"	7,777.4	627 14	80 63	758,000,000	15.5	69,428 00	9.15 "	$27,843 30 Comp'd with No. 12.
11	Manual Labor..... (A Large Am. Gas Works.)	56 Regenerator furnaces, 8 retorts each. Stage floor.....	448	9' 6"	7,777.4	522 23	67 14	758,000,000	15.5	103,628 00	13.67 "	$62,042 50 Comp'd with No. 12.
12	Hypothetical Slopers..... (A Large Am. Gas Works.)	22 'Drory" Slopers (Cost estimated and Americanized)..	198	15'	19,141+	869 43	45 42	758,000,000	12.0	41,585 50	5 48 "	.....
13	Coze Inclines.....	8 Arndt-Coze furnaces, 7 retorts each ..... (Operated a few weeks only.)	56	10' 10⅛"	11,784	729 89	61 93	131,980,000 (Had they worked.)	12.0	15,260 16	11.56 "	(Were not a success.)
14	Slopers	8 Regenerator furnaces, 7 retorts each. (England) .... (Hypothetical case.)	56	20'	16,167+	501 83	31 04	181,070,400	8.0	8,069 24	4.45 "	.....
15	Manual Labor..	20 Regenerator furnaces, 7 retorts each. (England)..... (Same as above.)	140	9'	6,466.8	244 76	37 84	181,070,400	12.0	13,948 97	7.69 "	Saving by No. 14, $5,879 73
16	Manual Labor.....	12 Fire-bar ground-floor furnaces, 5 retorts each..... ...	60	D's 8'3" x 21" x 13"	6,000 (Annual ave'ge.)	226 00	36 66	69,600,000	26 0	14,934 00	24.56 "	....
17	Water Gas	"Lowe Improved," one set. Generator 13 ft. 6 in. × 6 ft..	..... (In operation.)	13'6" x 6'	348,000	15 850 00	45 54	69,600,000	.....	3,851 00	5.53 "	(Cost of Mat. higher than C. G.)
18	Hypothetical Slopers.....	3 Regenerator furnaces, system "Drory," 6 retorts each.....	18 (Hypothetical)	15'	19,141+	779 00	40 69	69,600 000	12 0	6,923 00	9 94 "	Saving $8,011 00 Comp'd with No. 16

NOTE.—All above are, or have been, in operation, excepting the "hypothetical" cases only. These are based on known, well-authenticated results obtained elsewhere.—F. E.

*Since the writing of this paper, Mr. E. Drory has been promoted to the charge of the same company's business at Berlin, Germany.—F. E.

Mr. Egner having explained that errors existed in Tables Nos. 10 and 11 (those referring to a large American gas works), and having supplied the corrections therefor (the paper as printed in the JOURNAL contains the emendations referred to), read the following letter, from Mr. W. S. Miller, of the Cincinnati (Ohio) Gas Light and Coke Company, which letter was received by Mr. Egner while collecting the facts and figures on which his paper was based :

"We are using oval retorts exclusively, and have been for the past 15 years; but for machine stoking a D retort can be used to the same advantage as an oval. The charging machine can serve D or oval retorts without any alterations, but on the drawing machine the form of rake head must be shaped to correspond with the retort. The size of retorts in use at our East End Station, and also at our new No. 5 at West Station, are 16 inches × 25 inches × 9 feet 6 inches long, inside measure. At the East Station we have 56 benches of 8's, and in No. 5 we have 52 benches of 9's. The figures I will give you will be the results and workings of our East Station, as at the West Station, in the old works, we only discharge the retorts with machine, and charge with scoop by manual or hand labor. The average weight of charge is 330 pounds, time of burning 5 hours, one-fifth of the total number of retorts working being drawn and charged every hour. The furnaces are charged in rotation, the center retorts of one-fifth of the benches working being drawn every hour. When 25 benches are working it is unnecessary to have more than 9 retorts open at any one time. There are never more than 3 retorts drawn from any bench during one hour, and, with the exception of those drawn from center of bench to charge furnace, retorts are never drawn from benches in numerical order, but from every other bench, thus allowing sufficient space for the charging machine to charge the last 3 retorts drawn before the next 3 retorts are discharged by the drawing machine. The actual time required per draw, or the time from the slacking off of first retort until the last lid is closed, divided by by the number of retorts drawn and charged, will not average to exceed 50 seconds. The weight of charge of coal per retort would be the same whether the labor of drawing and charging was performed by hand or by machine stoking. Carbon incrustation does not interfere with machines when good practice is followed in scurfing retorts. The carbon should be removed from retorts every two months they are working. During the past year 1¾ per cent. of the retorts working were kept idle burning out carbon. Our benches are heated on the regenerative principle, and 15½ pounds of coke are consumed per 100 pounds of coal carbonized, when carbonizing two-thirds Youghiogheny and one-third Kanawha lump coal. A single pair of machines can serve 50 retorts per hour.

"The following is a comparison of the number of men required to work in carbonizing department when using coal from storage yard, the floor of which is on a level with cellar floor of retort house by machine stoking and by manual labor :

Retorts Working.		Machine Stoking. No. of Men.	Manual Labor. No. of Men.
448	2 pair machines.	36	75
368	2 "	30	65
112	1 "	9	19
40	1 "	4	7

"The above lists include the men breaking and distributing coal, engineers, helpers, lid men, cellar men or coke men and furnace men. Also, with the above labor the coke is quenched and deposited in storage bins, from which it runs by gravity over perforated screens into wagons for the market.

"By referring to the AMERICAN GAS LIGHT JOURNAL, November 16th, 1888, you will find a comparison of cost of machine stoking and manual labor, as compiled by our Mr. Norman G. Kenan, which was read at the Toronto meeting of the American Gas Light Association, by Captain A. Q. Ross; subject, 'The Ross Steam Stoker and Improved Charger.'

"For nine months in the year we can elevate coal direct from coal barges into retort house bins, and thus save the expense of coal men included in foregoing for purpose of comparison with hand working. When working without the coal men the yield per man in retort house, including engineers and helpers on machines, lid men, coke men, and furnace men, is 62,000 cubic feet per day. The machines are driven by steam. The amount of fuel used per machine depends upon the number of benches being drawn and charged by them.

24 Hours' Working.	Coke, Cwt.	Cylinder Oil.	Lubricating Oil.
200 retorts, working 5 hour charges, 1 pr. machine	43	½ gall.	½ gall.
112 retorts, working 5 hour charges, 1 pr. machine	36	½ gall.	½ gall.

"The cost of repairs on machines is less than on ordinary retort house tools. We have three pairs of machines at our East End Station; two pairs are always in use and one pair in reserve. These machines have been working continuously for about 11 years, and are, therefore, not new. The cost of repairs on stoking machines during past two years has been 26.100 of a cent per 1,000 feet of gas made, or $5.40 per day for four machines, the production of gas being 758,000,000 cubic feet per year.

"The cost of a drawing machine is $6,000; the cost of a charging machine is $5,000; the cost of coal hoppers would depend on the construction, being less if of combination of wood and iron than if built of metal.

"The bins at our new works just finished, including cost of columns

supporting them, cost about $250 per bench, and contain 500 bushels each. The cost of machine stoking will not exceed one-half the cost of manual in any works having at all times more than 40 retorts working. Machines have been working at Cincinnati for 17 years.

"Five benches is the minimum number that can be economically served by machine stoking; 16 feet between benches and side walls is the least space within which machines can be operated. An extra pair of machines is not necessary, if a sufficient force of transient men can be engaged to draw and charge retorts for 5 or 6 hours once a month, during which time the boiler of machine can be cleaned and the necessary repairs made.

"The engineers on machines are picked from among the laborers employed in the works. They are men who have the physical ability to perform retort house labor in the heat of summer, and are also possessed of sufficient intelligence to be entrusted with the care of a steam boiler after a few days of practice in charge of a competent engineer. The drawing machine engineer is paid a minimum wage, when 22 retorts or less are drawn per hour; for each additional retort fired up he is paid one cent per day additional. The charging machine engineer is paid a minimum wage, when 27 retorts or less are charged by him per hour; for each additional retort fired up he is also paid one cent per day extra wages.

"When more than 22 retorts are to be charged per hour an assistant is given the engineer on charging machine to fill coal hopper from chute. The helper or assistant is paid a minimum wage when he is put on, and three-quarters of a cent extra wages for each additional retort fired up.

"By paying them for extra work, as benches are fired up, there is no complaint from any of them, and they are always anxious to have the retort house working up to its maximum."

Mr. Egner then read from another letter, dated October 12th, 1896, from Mr. W. Ralph Herring, Engineer and Manager of the Corporation Gas Works, Huddersfield, England, as follows:

"My experience with inclined retorts dates from the year 1892, when having to increase the carbonizing capacity of these works, I went thoroughly into the question as to the comparative advantages of horizontal charging and inclined retorts, and, after carefully weighing up facts and figures, I was compelled to admit that the inclined retort system offered the greatest scope for economy and efficiency in the carbonizing plant of any gas works.

"After the necessary interval of the preparation of drawings, etc., I commenced the erection of a double bench, each consisting of 10 settings of 9 retorts, set at an angle of 32°, the mouthpieces of the retorts being through and through, charged from the central stage, which was 17 feet 6 inches wide, discharging on the two outsides of the floor line, the furnaces being placed on the inner side of the slope of the retorts.

"When these were ultimately got to work they proved to give very satisfactory results, so much so in fact that it was determined to abolish a large section of the then existing horizontal retorts, and erect in their stead a new retort house, especially designed by me for the accommodation of the system, and it is this one that you refer to as being described and illustrated in the *Journal of Gas Lighting* for November 19th last.

"First: As to the system. From the outset I have been a staunch believer in the ultimate possibilities of the successful accomplishment of charging and discharging retorts by gravitation with the minimum of hand labor; but I must admit that I never from the outset agreed with the original Cozè plan of the cast-iron, bent shoots. First, owing to the impossibility of getting a fireclay retort and a cast iron shoot, both subjected to practically the same temperature, remaining for any length of time in a tight and sound condition, owing to unequal expansion and contraction; and, secondly, owing to the liability of cast iron to swell and bulge and to become otherwise distorted, when subjected for any length of time to even a dull red heat.

"Secondly: I could not see how it was possible to get a level charge in the retort, assuming that the coal had passed the bend, as it would depend upon the speed at which the pit truck was allowed to be discharged into the mouth of the shoot. As, however, experience has proved the original pattern to be quite useless, it perhaps looks pedantic on my part to even mention my early opinions of the system, which were formed before I had any occasion to come to a decision with regard to the relative merits.

Practical Notes on Construction.—The regenerator furnace and the accompanying setting of retorts are undoubtedly of primary importance to the inclined, as also to any system of carbonizing, and the want of knowledge and a proper appreciation of the altered conditions of heating, have been the cause of the bulk of the failures of the system hitherto. The conditions of heating a bench of retorts placed at an angle of 30° to 40°, are undoubtedly of a different nature to a similar setting placed on an horizontal line.

"To overcome the difficulties as regards the setting, I have found it advantageous to practically divide it into 4 compartments regulated by 4 dampers. By this means we have not found the slightest difficulty in maintaining a uniform heat throughout the length of the retorts. As regards the distribution of the carbonic oxide gas from the producer, experience has proved it to be advantageous to distribute the same in two small gas flues, with small nostrils distributed along the full length of the retorts, the secondary air supply being brought up alongside each of the gas nostrils, these gas flues being on either side of the middle retort, between the latter and the outer retorts. I have further found it to be an advantage to reduce as far as practicable the area between the top of the fuel, when the furnace is full, and the crown of the producer, by filling it in with brick work, and conducting the carbonic oxide through the solid work with the necessary nostril flues into the longitudinal gas flues.

"Structurally the bench is built in such a manner that the iron work throughout (consisting of the buckstays, stage floors, coal storage tank, measuring chambers, elevators, conveyers, etc., including the hydraulic main and ascension pipes) is entirely independent of the brick work of the bench or setting, the only attachment being the bolts of the iron mouthpieces of the retorts. This will at any future time permit of the rebuilding of the whole of the brickwork comprising the retort bench and settings without in any way disturbing the iron work of the structure, and when it can be accomplished, as it has been, without in any way interfering with the present stability of the whole, it will be admitted to be a great ultimate advantage. I prefer the ascension pipes on the low or drawing ends of the retorts, as I find that the trouble from stopped ascension pipes when in this position is practically nil, owing in my opinion to the slight condensation which takes place in the pipe, keeping the bottom mouthpieces comparatively cool and moist. It is quite a mistaken idea, although a very prevalent one in this country, that this slight accumulation of the liquor in the lower mouthpieces of the sloping retorts arises from the same running down out of the retort; but on reflection it will hardly be conceded that it is possible for such to run down a red hot retort. Undoubtedly, whatever accumulates arises from the condensation in the ascension pipe.

"*Taper Retorts.*—Experience has proved it to be of considerable advantage to have a slight taper on the interior sides of the retorts, to facilitate the discharging of the same, the amount of taper in our retorts being 4 inches in the 15 feet length. This is sufficient to overcome the inequalities of the retorts produced by the accumulation of carbon or the general wear and tear of the same. Whilst on this topic I may say that my experience inclines me to adopt a steeper angle than the orthodox 32°, chiefly with the view to the more ready discharging of the retorts; the means we now have of charging them being such as to enable us to regulate the charge almost irrespective of angle, provided the same does not greatly exceed the natural angle of repose. Our method of charging the retorts is, I think, fully described in the article previously referred to, except perhaps the transversing shoot, which is employed to conduct the coal from bottom of the measuring chambers into the retort mouthpieces. One light, steel traversing shoot is employed for each horizontal row of retorts throughout the bench, which has a sliding shoe-piece at the base, which traverses in guides set at the same angle as the retort base. In the interior of this shoot a compound valve or flap adjustment is provided, by which the stream of coal is regulated to just such a speed as to be traversing at the pace required by the time it gets to the shoe-piece of the shoot, as is sufficient to conduct the same in a steady stream to the bottom of the retort, where it will gradually back up from the bottom stop-piece to the full length of the same, and the adjustment of these can be varied at will by the movement of one small lever and thumbscrew. In practice these have proved to be very efficient instruments, and can be strongly recommended to your attention. Although my name is associated with their origin, experience has proved them to be the best of the various forms we have tried.

"*Cost of Installation.*—The structural cost of an inclined retort bench need be no greater than a horizontal retort bench constructed in an equally substantial manner, and equipped with horizontal charging machinery; and if we take the total cost of the carbonizing plant, including the cost of the retort house and roof, the capital cost per ton of coal carbonized is less than with a retort house worked with horizontal charging machinery. For instance, in our new retort house, the building is 87 feet wide, which I may say is no wider than many retort houses in this country at present working 20 feet through horizontal

retorts with charging and drawing machinery. In our case we have a double bench, each of 15-feet retorts, which is equal to 30 feet of retort in the width of the house; thus a very considerable saving in retort house structure and roof is obtained with the sloping retort, taking no credit for the ground space occupied. As a matter of fact, we could even have done with a little less width than 87 feet, but had we left the narrow strip of land it would have been wasted for other purposes.

"*Wear and Tear and General Stability.*—There is no reason whatever why an inclined retort bench should not remain equally stable as a horizontal bench, provided it is properly stayed at the outset. In fact, my experience inclines me to conclude that it will remain even more stable, owing to the natural tendency of the bench to come forward on itself, but which if properly stayed is retained in its proper position. Across the fronts of the settings of retorts we have 4 × 4 × ½-inch T-iron bars, which not only stay the fronts, but also take the weight of the retort mouthpieces. There is very little possibility of a retort bench moving if it has been brought up to and maintained at its ordinary heat for a few days, as by this time the whole of what was originally numberless pieces of firebrick has become thoroughly fluxed into a solid mass. Therefore, the only danger is when the bench is first being warmed up, but if this is done steadily there is no reason why it should not be as equally sound and plumb on the face a few years afterwards as when it was originally put in. The wear and tear on the retorts is actually less, and the repair and pointing of the same are easier than in horizontal settings; and, once the men are used to the work, the cost of renewal of the settings is the same.

"*Carbonizing Results and Practical Working.*—During the present year, and from the end of January last, the whole of the out put from these works had been produced from the inclined retorts, varying from 3 millions to 1 million per day, and the results obtained from the coal have been slightly superior to what we obtained formerly from the horizontal retorts. This I attribute to the fact of the retorts being quicker closed, with a consequent less waste of gas than was formerly the case. Given the same heats and the same class of coal, slightly superior results can be obtained from the inclined retorts. The quality of the gas I find in no way injured by its travel from the upper end of the retort down the full length of the same to the ascension pipe. This is perhaps contrary to past experiences, bnt it may be due to the fact that we have far less areas between the top of the coal and the crown of the retort than was formerly the case, and to which the gases generated were exposed along the heated surface of the retort.

"The wages cost of carbonizing is one-half of what it formerly cost us on the horizontal retorts charged by hand, and this is accomplished with the expenditure of only from 3½ to 4 hours actual duration of physical labor on the part of the operative, and which, as you will know, is far less irksome and trying than with the older methods. Our men work 8-hour shifts, and do four draws during each shift, the draws averaging from 40 to 50 minutes, and, at the very extreme, never more than an hour. The charging operation is performed by bringing the traversing shoot to the mouth of the retort, when the drawing of a lever allows the charge of coal to be sent into the same. The drawing operation is performed by first bringing the traversing shield, which runs on rails on the sides of the retorts, alongside the bed which is to be drawn, the operatives then slacken the mouthpiece doors, withdraw the stop with the same implement, when the coke invariably rushes forward against the shield or screen, and is directed below the stage door into wagons, where it is automatically quenched, and afterwards moved by mechanical means to the overhead coke storing gauntry.

"Should the coke from unusual causes require any assistance to fall from the retorts, a slot is provided in the traversing screen, through which the operative inserts a poker bar, which passes up the retort and is made to disturb any bits of coke remaining thereon.

"I may add that the bench, from the laying of the first brick to the completion of the same, occupied a period of only seven months, by the end of which time we were making gas therein."

Discussion.

Mr. A. C. Humphreys—The members of this Association are to be congratulated that Mr. Egner has placed this paper before them. The subject of inclined retorts was exciting much interest in this country some six years ago, and it is time that this interest was revived. Mr. Egner has covered much ground. He gives us an outline of the history of the development of this system, and in doing so takes occasion to justly point out that a new system may be condemned on account of weakness which may be not inherent in the system but only incidental to its development. How often do we find this failure to distinguish between errors of design or execution and errors in principle. When this system was first brought forward I was inclined to believe that it would succeed; but experiments which were made under my direction with inclined retorts as part of a combined coal and water gas process, tended to change this belief, and my examination of the best plant in operation in England, in the year 1890, served to almost complete this change. The plant last referred to was particularly disappointing on account of its complication and of the length of time required for charging and discharging. So complete have been some of the failures, both in Europe and in this country, that it undoubtedly rests with the friends of the new system to completely demonstrate that it has been developed beyond the experimental stage. Mr. Egner has told us of the work now being done in Germany and England, and he especially refers to the work of some of the accomplished engineers of the great Imperial Continental Company, of England, referring most in detail to the work of the latter Company's Vienna station. During the past summer, through the courtesy of the Company's Chief Engineer, Mr. Corbet Woodall, I visited the "Erdberg" works at Vienna, and although I did not have the pleasure of examining the installation of inclined retorts in company with Mr. Edward Drory, the former resident engineer, I obtained, through Mr. Koerting, Mr. Drory's former assistant and successor, every facility for observing their operation. I found in operation 10 benches of 9's, 12 feet long, worked on 4-hour charges, two gangs 12 hours each, two men each gang on the upper side, and five men each gang on the lower side, these five men, in addition to actual stoking, removing the coke to the yard. Mr. Koerting stated that if other arrangements were made for handling coke three men less on each shift could do the work on the lower side, making the total force on the retorts two above and two below for each shift. The charge per retort was from 180 to 200 kilos., say 400 to 440 pounds. Capacity per retort per day, 340 cubic meters, or, say, 12,000 cubic feet. A retort was discharged and charged in a little less than one minute. Mr. Koerting stated that they discharged and charged 30 retorts in 20 minutes. Here you will note the great advance made over the original Coze system. One very interesting point was shown by Mr. Koerting, namely, that, after the men were broken in, no special measuring hoppers were required for delivering a measured quantity of coal to the retorts, as the men quickly acquired the knack of regulating the amount to be charged by simply manipulating the hopper valve. This point had developed in the use of the apparatus equipped with measuring hoppers, and gradually the latter has fallen into disuse. Moravian coal was used, which yielded about 29½ cubic meters per 100 kilos., or, say, 4¾ cubic feet per pound. The retorts I saw had been 400 days in action and appeared to be in good condition. It was claimed that they outlasted the horizontals. These benches were set face to face so that the coke was discharged into the space between them; that is, into the center of the house. This necessitated the wheeling out of the coke into the yard, as previously referred to. The Company is building some still further improved benches at another of its works—Berlin, I believe. In this case the retorts are 15 feet long and will receive each about 600 pounds per charge; will produce per day each about 500 cubic meters, or, say, 17,500 cubic feet. The benches will be set back to back, and only the benches and coal handling machinery will be covered in. The retorts will be discharged direct into the open coke yard. This construction in part explains the decreased cost of installation as compared with that of the benches now in operation. Of course, a further saving is to be found in the fact that the increase in cost due to increase in length of retorts is not at all in proportion to the increase in capacity so obtained. The engineers in charge had made a careful study from their standpoint of the relative costs of construction and manipulation of various different retort house systems. The results they had tabulated so as to show the comparison at a glance. Mr. Koerting was good enough to present me with one of these tables, and this I now have with me. The chief value to us in such a table, covering, as it does, foreign conditions, is the comparison, not the actual cost figures. Mr. Egner has shown a table somewhat after the pattern of the Vienna table referred to, and he shows the actual figures of cost and makes comparisons between the costs of different systems, some being based on European conditions and some on conditions which here obtained. I feel that such a table should be used with the greatest care and forethought or we are liable to fall into serious error. Leaving out of account for the moment absolute costs, let me show the ratios which exist between these costs of construction and manipulation, as shown by the Vienna Table. The cost of construction in each case includes building, furnaces, coal breaking and elevating machinery, if any, and stoking machinery, if any, but does not include land. Manipulation covers operating labor, 5 per cent. on construction cost, wear and tear on apparatus, and, in the case

of the direct fired furnace, there is included the cost of the extra fuel used to compensate for the inefficiency of these furnaces as compared with the generator furnaces employed in the other cases. Land rent or interest on land is not included, as probably it was thought that this item was not sufficiently variable to make necessary its inclusion. If there is, however, a considerable variation here found, this item must necessarily be included in a fair comparison.

Ratios of Construction Cost and Cost of Manipulation, each plant with capacity of 9,000,000 cubic meters (= 318,000,000 cubic feet) per year of 200 days, or 45,000 cubic meters (= 1,590,000 cubic feet) per day.

	Relative Cost of Construction.	Relative Cost of Manipulation.
Inclined Retorts—		
1. Proposed Coze system, as designed at Vienna—to include further improvements over existing plant	1.0	1.0
2. Coze system, as improved at Vienna, and now in operation	1.2	1.35
Hydraulic Stoking—		
3. Generator furnaces (Hasse-Didier)	1.94	2.28
4. Direct firing furnaces	1.54	3.66
Manual Labor—		
5. Generator furnaces (Hasse-Didier)	1.54	2.67
6. Direct firing furnaces	1.03	4.02

According to this table the results obtained at Vienna by use of the inclined retorts compare most favorably as to cost of construction and manipulation with the older systems. This advantage is still more apparent by the latest form of the Drory-Coze system, if the estimates are realized; and examination of the details develops no reason for doubting this. The table is also interesting and instructive as showing in a marked degree that cost of construction should not be considered without also considering the involved cost of operation, and vice versa. It is to me a source of sincere regret that the demands upon my time during this summer's trip to Europe were so many any so exacting that I failed of an opportunity to visit the improved installations of "slopers" in England. In Mr. Egner's tables, as in the original, the yearly make is taken as 200 times the maximum daily make. This in many localities is a fair assumption; but to calculate the total yearly labor, by multiplying the maximum day's labor charge by 200, may in my opinion be actually misleading. There will be a labor charge for 365 days, and as the make is reduced below the maximum the reduction in labor charge will not be in proportion. Otherwise it would not be true that the cost for labor per thousand is lowest when the works are operated at maximum capacity. Let us see how the ratios of costs of manipulation look when we amend the Vienna table by taking the total labor for the year as 300 times that for the maximum daily. The fact is that any such assumption can only be approximately correct, even for purposes of comparison; for the differences in systems will probably affect the question as to how nearly the daily cost for labor can be kept in proportion to the daily make.

AMENDED TABLE.—*Ratios of Cost of Manipulation..*
(See previous table.)

	On Basis of Yearly Labor, 200 Maximum Daily, as in Previous Table.	On Basis of Yearly Labor, 300 Maximum Daily.
Inclined Retorts—		
1. Proposed further improved Drory-Coze system	1.00	1.00
2. Improved Drory-Coze, as now in use in Vienna	1.35	1.36
Hydraulic Stoking—		
3. Generator furnaces (Hasse-Didier)	2.28	2.33
4. Direct firing furnaces	3.66	3.59
Manual Labor—		
5. Generator furnaces (Hasse-Didier)	2.67	2.80
6. Direct firing furnaces	4.02	4.02

The differences here shown between the two sets of ratios are not very serious, but they serve to show the necessity for care in arriving at a correct basis for comparison. In tables Nos. 16, 17 and 18, Mr. Egner makes a comparison between construction costs and costs of manipulation for coal gas, manual labor, water gas and "slopers;" all on the basis of a maximum make of 348,000 cubic feet per day. I think Mr. Egner's paper would have been more valuable if this comparison had been omitted. Water gas cannot be fairly brought into such comparisons as we are now considering. To make such a comparison fairly it would be necessary to include additional items. As previously pointed out, costs of land and land rent are not included; and manifestly they should be if water gas is to be brought into comparison, for water gas plant occupies relatively much less ground space than coal gas plant. Also, as Mr. Egner himself shows by a side note, cost of material cannot be omitted when comparing final costs of coal gas and water gas. Even in comparing the 6 cases shown in the Vienna table, the questions of land can hardly in fairness be eliminated, for the diagrams accompanying the Vienna table show that in case No. 1 (improved Vienna Coze) the space of land occupied is much less than in all the other cases, and is only about one-half of that occupied by each of the last four cases.

In a note attached to Table No. 16, Mr. Egner speaks of the maximum make, and speaks then of the yield being 4.80 per lb., gas *sold*. I cannot see how the gas sold has anything to do with the question of manufacture. If it were so, the most efficient system of manufacture might be damned by a wretched system of distribution. I know that some of our friends across the water are inclined to figure everything on the basis of gas sold, but I cannot think that there is any warrant for such a practice. The cost of the gas made should be arrived at by dividing the sum of all manufacturing items by the amount of gas made, then leakage per thousand should be calculated, by multiplying the amount of unaccounted-for gas by the cost per thousand for manufacture, and then dividing by the amount sold; and, finally, the cost per thousand of distribution and all other expenses should be obtained by dividing the sum of all such other items by the amount of gas sold. The sum of these several costs per thousand should equal the total cost of operation divided by the gas sold. This system serves for a thorough analysis of results, which the other system does not; but apart from the fact that there is an error in principle in such a comparison as that of Tables 16, 17, and 18, I find that the comparison appears to be in error as to details. I presume that in preparing these tables Mr. Egner has had the Norfolk works in mind. I note he has allowed 4,536 square feet for 12 benches of 5's, direct firing furnaces, and he has put the cost of a building occupying such a space at $4,200. The space here allowed is ample, but the cost of building is decidedly low. Under average conditions, $750 per bench complete is a low figure for 5's; $1,000 to $1,250 would be safer. I think that to cover these two items, not less than $6,000 should be added to the estimate. This addition would call for $360 additional cost of manipulation to cover interest. I note that the cost per 1,000 of manipulation is shown as 24.56 cents. This I think should be 21.4 cents if figured on Mr. Egner's estimate. In a note to Table No. 16 it is stated that the estimates are only carried to outlet of retort houses, and do not include scrubbing, condensing, etc. In Table No. 17, water gas, we find $3,000 taken as the cost of building to hold the water gas plant of capacity of 348,000 cubic feet per day. Evidently Mr. Egner has had in mind a single 6 feet set, double superheater, without reversal of steam, same as in his works. The Norfolk retort house is, I believe, about 54 feet wide and 138 feet long, outside measurements. Some small attached buildings at one end are used for office, photometer room and engine room. If we lay out 84 feet of this building, we have a space 54 × 84 = 4,536 square feet, which is the space allotted in Table No. 16 for the 12 benches of 5's. The balance of retort house is 54 × 54 = 2,916 square feet. Adding the engine and photometer rooms we have 3,204 square feet. In Table No. 17, the building to cover 4,536 square feet costs $4,200. In Table No. 17 the building costs $3,000, space not given. Calculating by proportion, which would here be approximately correct, this building would cover a space of 3,240 square feet, or a little more than the part of retort house and the two outside rooms as just referred to. But the fact is that in this space there actually stands one single set of 6 feet double superheater water gas apparatus, and two old Granger-Collins, 5 feet single superheater sets. Furthermore, the condensers and scrubbers for all these sets are here to be found. Certainly, then, the comparison as to cost of buildings is not fair. As a matter of fact, in a generator house 38 feet × 47 feet = 1,786 square feet, and a boiler and engine house (which need only be a lean-to) 28 feet × 42 feet = 1,176, total 2,962 square feet, we can very comfortably accommodate four 6 feet sets of double superheater apparatus, including generating apparatus proper, engines, boilers, pumps and condensers and scrubbers. This apparatus, instead of a capacity per day of only 348,000 cubic feet, would have a capacity of 1,400,000 cubic feet, But the condensers and scrubbers do not belong in this comparison; omitting them, we can put in four seats of double superheater 6 feet reverse steam apparatus, which would have a capacity of 1,600,000 per day. The analysis here given, if correct, shows that Mr. Egner allows for floor space over 9 square feet per 1,000 daily capacity, including condensers and scrubbers. The

layout which I have quoted would only require a shade over 2 square feet, and this includes condensers and scrubbers. Omitting the latter, we find the space to be 1.85 square feet per 1,000, and this is liberal even for these smaller sets. In larger installations this difference is much more marked. For instance, to take an extreme case, and a well known one, there is a modern double superheater, reverse steam plant in successful operation, 6,000,000 cubic feet per day capacity, the generator house being 35 ft. x 106 ft., or 3,710 square feet, equal to less than .62 square feet per 1,000. This does not include engines, blowers and boilers. Allowing ample space for these would still only show .92 square feet per 1,000. But I find I cannot agree with Table No. 17 in other particulars. The cost of apparatus is given as $10,500. Looking over some of my old prices I find this would include condensers and scrubbers. As already shown these should not be included for this comparison. Then there is an item of $2.000 for "boiler feed pumps, oil tank and pump, etc." The question arises, "Does the item oil tank cover storage tank or supply tank?" A moment's examination of the figures shows that it includes the storage tank. But why should storage of material be included in the case of water gas and not in the other cases? If it were included in both, then, of course, it would show a decided advantage for the water gas, as oil and fuel in the latter case do not require one-half the space that coal requires in the other cases.

In Table No. 18 the cost of the 3 Drory-Coze benches is taken as $9,822, or $3,274 each. But Table No. 1 shows the cost of benches of 9's, as $5,797 each, or $643 per retort. Even if you could build 6's as cheaply in proportion as you could 9's, the cost for the former would be $3,858 per bench. But it is about correct to say that, if we increase the number of retorts from 6 to 9 (namely, one-third), the cost per bench will be increased only about one-quarter. But, as shown, Tables Nos. 1 and 18 show a less proportionate cost in case of 6's than in case of the 9's. I am sorry to have to differ so greatly with Mr. Egner as to these comparisons, for I find myself in sympathy with him as to other points of the paper. I think we can all afford to accept Mr. Egner's advice and give careful attention to the merits of "slopers." I am also sorry to have taken up your time in a lengthy discussion of a side issue, but as Mr. Egner brought up this side issue, and brought it up in a way which I feared might be absolutely misleading, I felt I was fully warranted in discussing it somewhat in detail.

Mr. Geo. T. Thompson called attention to the statements contained in Tables Nos. 7 and 8, which referred to a ground floor house and a stage floor house, respectively, and he declared that the cost per 1,000 cubic feet for manipulation alone was overstated by some 40 per cent. Mr. Thompson was quite sure that his statement was accurate, for he happened to know the exact details of the working of the retort houses noted in the year 1895. He, however, also knew that Mr. Egner's figures were likely based on the practice followed in the works some years ago, but many improvements had been made there since. He further thought that Mr. Egner's paper went to show that much advance bad been made in the theory and practice of the setting up and working of inclined retorts since the latter system was introduced a comparatively short time ago.

Mr. W. S. Miller said he was very much interested in Mr. Egner's paper. He had supposed, however, contrary to the result reported by the author, that it would cost more to erect steam stokers in this country than in Germany.

Mr. Egner then closed the discussion. He regretted that the Association's time was so limited that the paper had to be so hurriedly disposed of, for it had taken much time and study to prepare it. In the main, he agreed with the points made by Mr. Humphreys, although there were some claims made that he could not fully indorse. Later on he would reply to the remarks over which there was disagreement, when he had had time to make the necessary comparisons. He did not think Mr. Thompson meant to contradict him, but the retort houses mentioned in Tables Nos. 7 and 8 did really exist at one time in the state and way that he had noted. Improvements had likely been made in them, and improved machinery for elevating coal and so on could easily be held accountable for the "overstatement" of 40 per cent. Replying to Mr. Miller's remark, he could only say that he used the figures sent him by Mr. Drory, and the American figures were based on what could actually be done in that line in this country to-day.

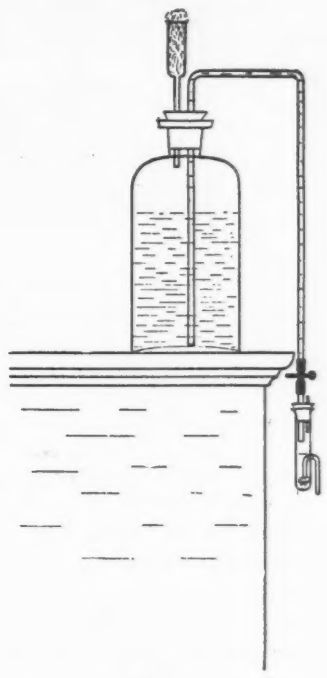
On motion of Mr. Littlehales a vote of thanks was passed to Mr. Egner for his excellent paper.

(To be Continued.)

Rapid Measuring Pipette.

Mr. Edward L. Smith calls attention, in a recent issue of the *Journal* of the American Chemical Society, to a handy device for the purpose explained.

The apparatus described below is a device for rapidly measuring and discharging a definite volume of liquid. It may be well to state at this point that the principle is not applicable in all, or in even the majority of cases, where it is desired to measure and discharge liquid reagents in the laboratory. Where extreme accuracy is essential, the ordinary pipette or a burette must still be used. Perhaps the best way to explain the utility of the apparatus will be to state the exact use to which it is put in our laboratory. In the course of some experiments with sand filters, samples of the different effluents as well as of the applied sewage were taken daily, treated with a small quantity of a concentrated sterilizing agent, and an analysis made each week of the combined daily samples.



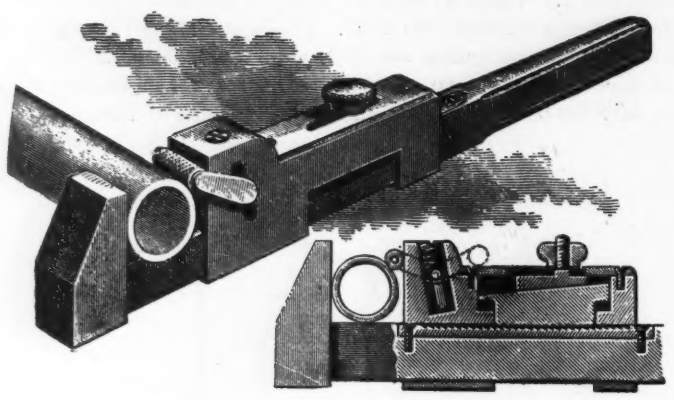
It was to measure and discharge this sterilizing solution that the apparatus was devised. The quantity added in each case was 5 cc. Of course a variation from that amount of one or two-tenths cc. would not materially affect the results, and the great advantage in convenience and rapidity over the use of the common pipette for the same purpose is admitted by all who have seen the apparatus work. A large bottle forms the reservoir. The stopper of this bottle carries two tubes. One simply serves to admit air, and contains a loose plug of cotton to exclude dust, etc. The other tube is bent to form an ordinary siphon, and the end of the longer limb is attached to a short glass tube by means of a rubber connection, provided with a pinch-cock. The short glass tube to which reference was just made passes through a stopper inserted into the mouth of an ordinary test tube. Through a hole blown in the side of this tube another glass tube, bent to form a siphon, is inserted and fastened in place by a piece of rubber tubing of the proper size, slipped on over the tube. The leg of the siphon inside the test tube is of such a length that when the pinch cock above is opened and the liquid allowed to enter the test tube, 5 cc. will be automatically discharged when the level of the liquid has reached a mark on a line with the top of the bend in the siphon tube.

The apparatus can be constructed in a few moments in any laboratory, and for purposes to which it is adapted it will, I am sure, be found satisfactory. It may be asked, "What is the advantage of the form suggested over the ordinary burette with supply tubes?" The answer is, it does away with the necessarily oft-repeated filling of the burette, and there is but one mark to watch in making the measurement—that previously mentioned, on the test tube. The tubing used is of such size that a rapid discharge is insured, the time required being less than would be the case were a burette employed.

Dixon's Pipe and Nut Wrench.

Thomas Dixon, of Highland avenue, McKeesport, Pa., has secured letters patent covering a wrench fitted with a roller jaw fulcrumed in arms on its movable jaw. The illustration shows the wrench in use, and also gives a sectional view of the device. Within the movable jaw is a recess in which is a block having on its bottom teeth adapted to en-

gage teeth in the top of the wrench handle, springs normally holding the teeth of the block up out of such engagement, and permitting the movable jaw to slide on the handle. The top surface of the block is inclined, and is engaged by a longitudinally sliding wedge to move the



block down against the tension of the springs and into engagement with the teeth on the handle, a thumb nut on a screw projecting upwardly from the wedge facilitating its ready adjustment as the movable jaw is to be moved forward or backward or fixed in any desired position relative to the outer jaw. The tool is adapted for use as a pipe wrench by the addition of a roller jaw journaled in arms on a transverse shaft or pin which slides in bearings near the front end of the movable jaw, a spring resting on the shaft being engaged by a screw block. As shown by the dotted lines in the sectional view, the roller jaw is moved to a rearward position when the tool is to be used as a monkey wrench, being swung forward only when it is desired to use the wrench as a pipe wrench.

The Origin of Waves of Light.

The London *Journal* reports that at the last Annual Meeting of the German Association of Gas and Water Engineers, Dr. W. Wedding, of Berlin, read a paper on the above subject. It has since appeared, by the author's permission, in the *Zeitschrift für Beleuchtungswesen*. In the following abstract of its contents, results are given in English terms, on the basis of 1 English standard sperm candle being equivalent to 1.14 Hefner units of light.

The sun has for thousands of years been the nucleus of a turmoil of scarcely diminishing intensity. Life and subsistence on the earth are only possible on account of this uninterrupted disturbance on the sun's surface. The energy set free is dispensed to the earth, not by molecular transference, but by oscillation of the ether—a hypothetical material assumed by physicists to pervade all bodies and all space. Its very existence is only demonstrable by certain effects, for the production of which a gas of the highest conceivable tenuity appears necessary. The ether is the medium of radiation by which the sun's activity is propagated abroad through space to us; and were the ether to come to a state of rest, all life on the earth would cease. The ether is not transported, but is merely stirred into an undulatory motion. Each particle is subject to a certain number of oscillations in unit time, and these recur within the same limits of space. For every movement propagated through the ether, there is a length of oscillation, or wave length, standing in fixed relation to the number of oscillations in a given time. If $\lambda =$ the wave length, $\pi =$ the frequency, and $v =$ the velocity of propagation, then this relation is expressed by the equation $\pi\lambda = v$. Assuming that v is constant at 300,000 kilometers per second, then π may be found so soon as λ is known.

All the ether particles need not have the same frequency at one time, but as the velocity is constant, a certain wave-length corresponds to every different frequency. In other words, different radiations may be propagated simultaneously. With a given wave length and a given frequency, the amplitude of the oscillations may vary; or, more briefly, the intensity of the radiation may vary. In electrical phenomena, Rubens found wave lengths of 3 centimeters; and the corresponding number of oscillations per second would be about 10,000 millions. When the number of oscillations is about 60,000,000 millions, and the motion of the ether extends to bodies, their molecules begin to vibrate, and the vibration becomes apparent as heat. The electrical resistance of fine wire brought into the course of these rays becomes changed, and the radiation may be measured by the bolometer. The point of juncture of two dissimilar metals if brought in the course of the rays becomes a source of electromotive force. A thermometer placed in the course of the rays rises. The human body is sensible of these rays, which occasion the feeling of heat.

The more frequent the oscillations, the shorter is their wave length; and with 400,000,000 millions of oscillations per second, our eyes receive the impression of red light. As the number of oscillations rises, there succeed the impressions of orange, yellow, green, blue, and violet light—800,000,000 millions of oscillations giving the last color. If all the oscillations between these numbers occur at the same time, the impression produced is that of white light, such as sunlight. Oscillations of less frequency than 400,000,000 or more than 800,000,000 millions give no direct impression to the human eye; and all shades of color lie within that range.

The field in which the lighting expert works is thus restricted. He aims at finding a substitute for sunlight at times and places where that is not available; and since light that differs greatly from it is distressing to the eye, the substitute must resemble sunlight as closely as possible. Petroleum light and candle light are red; electric glow lamps and gas lights, red to yellow; incandescent gas lights, green; and electric arc lights, blue—in comparison. Perhaps the flame of pure acetylene most nearly resembles sunlight. The sun, however, dispenses light and heat, both of which are essential to existence. But man often desires more of one or the other than Nature affords at the time; and the problem to be solved in practice is the dissociation of the light and heat rays. In the daytime, when the sun furnishes both, man may require more heat than it gives directly—perhaps for personal comfort, perhaps for engines and machinery. Under other circumstances, he may have a surplus of heat, but needs more light; and he will then endeavor to produce light rays only.

Much has been done to further this endeavor; but how much yet remains may be judged from the fact that in electric lighting 90 per cent. of the total energy is expended in heat rays, and in ordinary gas lighting only 1.5 per cent. is given forth in light rays. The demand for more light progresses with its partial gratification; and, concurrently with the reduction of the heat developed, sources of light have gradually become more powerful. Sunlight is still far from being well imitated artificially, either in color or in intensity. On a bright day, the sun's light falling vertically on white paper on the earth's surface is equivalent to that of 288,000 candles. Light of this intensity can, indeed, be produced from the electric arc; but the radiation from the small area is so great compared with that from points in the vicinity, that the effect is merely to dazzle.

In daylight, all points are uniformly illuminated; and the natural transition from light to darkness also is easy. Dazzling contrasts are absent, and a harmonious uniformity prevails which artificial lighting has not successfully imitated. The human eye, which is able to distinguish objects by a light of 1-4000th of a candle 39.37 inches distant, is too sensitive, and is particularly offended by the arc lamp. Hence the favor with which the incandescent electric lamp was received. Artificial lights are usually associated with much heat. We may escape the sun's heat by passing into the shade, and yet have the benefit of its light; but if we pass into shade to avoid heat rays from artificial lights, we are in darkness.

The aim in this branch of technics is, therefore, to obtain for a given expenditure of energy as much light and as little heat as possible. Some figures will indicate what has been accomplished. One candle hour obtained in various ways requires an expenditure of material or energy which if turned solely to the production of heat, would give the following amounts:

	Kg. Calories.
Petroleum lamp (light measured in horizontal plane)	36.5
Coal gas—	
Bray burner " " "	75.8
Argand burner " " "	57.0
Incandescent burner " " "	11.4
Incandescent spirit lamp " " "	12.1
Acetylene " " "	10.2
Coal gas—	
Wenham burner (mean hemispherical lighting value)	21.0
Electric light—	
Incandescent " " "	3.0
Arc " " "	0.3

Judgment based on these figures must be modified by considerations of the power of the light in each case, and of the actual cost of its production. The unit light in the above cited methods ranges from 15 to 1,000 candles. The figures show, however, how great have been the advances in the application of gas to lighing purpurposes. Taking coal gas at $1.12 per 1,000 cubic feet, petroleum

at 21.8 cents per gallon, and electrical energy at 14.4 cents per kilowatt-hour, the following values for the cost of 1,000 candle hours may be found:

Petroleum lamp	20 cents.
Coal gas—	
Bray burner	60.4 "
Argand burner	44.8 "
Wenham burner	16 "
Incandescent system	8.8 "
Electric light—	
Incandescent	52 "
Arc	5 "

Each description will evidently find favor under certain circumstances. The gas and electrical industries are inherently opposed to one another, but the rivalry has immensely benefited both.

No impression is conveyed to the human eye by oscillations of the ether exceeding 800,000,000 millions per second. Rays having oscillations of greater frequency are very active chemically, and are at the root of the photographic art. Beyond these actinic rays, in exhausted spaces, we have those known as cathode rays, produced by the aid of electricity. At the opposite end of the scale, we find electrical phenomena accompanying the low frequency oscillations. The energy applied in Geissler tubes is almost wholly given out as light; hence their efficiency as light producers is very high indeed. This high efficiency is, however, practically wholly discounted by the unavoidable and very great loss of energy in transmission from its source to the tube. With more thorough exhaustion of the tubes, the bluish-red light ceases, and the rays, though dark, on striking the glass are transformed into light and heat rays, and a lovely green color is produced. But the whole of the energy is not thus transformed, for some of the invisible rays traverse the glass, and exhibit properties which Röntgen has already made known. Though the wave length and frequency of these rays are still in doubt, practical application has already been made of them. The revelation of others of still shorter wave lengths and higher frequency is quite within the range of probabilities; for though the human eye is only sensitive to rays of limited compass, yet with the aid of ingeniously and finely-made instruments, we may extend the limits of our knowledge. The energy brought by oscillations of the ether from the sun to the earth disturbs the equilibrium which would otherwise obtain here; and life consists in a perpetual struggle to restore quiescence. But man strives too keenly to allow Nature to pursue her course undisturbed. He wants more energy than the sun furnishes, and he applies to that stored up many years since in coal and other materials. The energy then derived by radiation from the sun he now uses to secure light in the periods of darkness.

The Velna Process for the Manufacture of Briquettes from Waste Coal and Mineral Tar.

The *American Manufacturer* says that the fuel question is in Europe more important than it is in this country with its great resources of black diamonds. Briquette making has become a great industry in Germany, Austria and France, and unsightly culm piles are being carefully utilized in those countries and made a profitable source of revenue. Brown coal has so far been the chief material for briquettes, but in latter days experiments with briquettes of solidified petroleum or residuum have been made which, however, did not result satisfactorily for the reason that the boilers were unable to withstand the intense heat developed by this kind of fuel.

L'Industrie describes a process devised by the chemist Velna who uses petroleum or mineral tar only for enriching culm and other inferior, formerly worthless combustibles, and produces briquettes from this material, the heating power of which is 30 per cent. higher than that of good coal. He first prepares a mixture consisting of petroleum or bituminous shale tar, oleine and soda in suitable proportion, and by this means the culm, slack or coal dust is cemented together. Three kinds of briquettes are produced in this way, namely, industrial briquettes for general firing purposes, gas briquettes for the manufacture of illuminating gas, and metallurgical coke.

The industrial briquettes make a very economical fuel, and furnish at the same time the highest number of heat units which our engines and boilers can withstand, that is, from 9,000 to 10,000. There is less ash and the ignition takes place much quicker than with coal, which means a considerable saving of time and fuel in getting up steam. The briquettes are solid, keep for any length of time, and there is no smell or oozing. By employing this mixture on peat, a fuel equal to the best coal is obtained, with the further advantage that it will produce no slag.

In order to make the use of petroleum residue, which is very rich in gaseous hydro carbons, practicable for the manufacture of gas, it is necessary to make the gas briquettes inexplosive and of handy shape. This has been fully attained by Velna in the preparation of this mixture. In the gas works at Brussels, 24 pounds of it were put into a retort, and although the temperature was brought up to 1500° centigrade, the gasification took place without explosion or any accident whatever. Such briquettes will produce gas which, in spite of the inferior and cheaper material used, possesses a much stronger illuminating power than the ordinary illuminating gas of to-day. The gas produced from briquettes is perfect as far as the the thorough mixture of its components is concerned, and it possesses the same density as the ordinary coal gas. No alteration of the mechanical apparatus or the system of distribution is necessary. As regards the by-products, tar and ammoniacal liquor, they are better and more abundant than in the distillation of coal alone.

For refining ores, and especially iron ore, we use coke which should be strong enough so as not to be crushed by the burden placed upon it. Coke from gas coal and produced in gas plants cannot be used very well for metallurgical purposes because it contains sulphur which would make the iron red-short. Only lean coal and anthracite contain no sulphur, or so little as to make their use harmless. The culm or dust from these coals treated with Velna's mixture, after being distilled or coked in closed vessels leaves a hard coke which possesses greater power of resistence to burden than any other coke. It is unnecessary to mold the prepared culm into briquettes before coking; it can be put into the coke oven in bulk without further ceremony. In this manner, large blocks of coke are obtained that can afterwards be broken up to convenient sizes. Experiments have shown that the leaner the coal or culm the harder the coke.

In 1892, experiments were made in the gas works at Brussels in order to determine whether coal dust or culm, treated with this mixture, could be utilized for the production of gas. It was found that one ton, either in bulk or in the shape of briquettes, furnished 450 cubic meters or nearly 15,000 cubic feet of gas of better quality than the ordinary coal gas.

At the works of Cochet-Maillard, of Paris, it was ascertained recently that a poor combustible, which by itself was worthless and developed only 4,000 heat units, yielded 6,400 heat units when enriched by 8 per cent. of the mixture, thus being fully equal to the average factory coal. In the same works 50 to 56 pounds of coal per hour were used to maintain a pressure of from three to four atmospheres, or from 150 to 170 pounds in three hours; 124 pounds of briquettes, consisting of 92 per cent. of anthracite culm and 8 per cent. of the mixture, maintained the pressure at four atmospheres and over for 3 hours and 20 minutes, or an average saving of 30 per cent.

A test run was made on one of the Belgian railroads with a locomotive fired with Velna briquettes. Three hundred and fifty gallons of water were converted into steam on this run by 348 pounds of briquettes. Thus one pound of briquettes was sufficient to evaporate one gallon of water. The combustion was perfect, the fire easy to control, and no clinkers were produced.

In France mineral tar, goudron de petrole, is used for preparing the mixture, either by itself or mixed with tar produced by the distillation of brown coal or bituminous shale. The mineral tar is produced by numerous pits in Auvergne in large quantities. This tar combines easily with fat bodies of the animal order only, and for this reason oleine is employed for accomplishing a partial saponification, which furnishes the emulsion constituting the mixture. The manufacture of briquettes does not offer any more difficulties than that of other agglomerates. The proportion of the mixture to be added varies between 100 and 200 pounds per ton of culm or coal dust, according to the quality of the latter. Brown coal, which by itself yields only 4,000 to 5,000 heat units, while coal produces 6,000 to 7,000, and which for this reason does not suit for all firing purposes, could by this process, be made a first-class fuel of a heating power of more than 8,000 heat units. The net cost of these briquettes would be very low, for the value of the by-products exceeds the cost of the raw materials.

The French railways and steamboat companies pay $3 for a ton of run of mine coal.

If culm or dust from a good coal valued at $1.20 would be taken for the production of briquettes, 6 per cent. of the mixture would be sufficient. The price of a ton of briquettes would then be as follows:

1,880 pounds of coal dust at $1.20 a ton	$1.13
120 pounds of the mixture at $12 a ton	.72
Cost of labor	.40
Total per ton	$2.25

If waste of a poorer coal be used, 10 per cent. of the mixture would be the proper proportion. Supposing the waste, culm or slack, costs $1 a ton, the price of a ton of briquettes would be $2.50 under these circumstances. In the first case, there will be a saving of 25 per cent., in the second of 16 per cent. Considering further that the heating power of briquettes exceeds that of the average coal by at least 25 per cent.. 1,500 pounds of briquettes would be equal in heating value to a ton of coal. This would mean also a great saving of storeroom on board of steamers.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

ARTICLES incorporating the Mason City (Ia.) Gas Light and Fuel Company have been filed with the Secretary of State, and application for a franchise from the local authorities will shortly be made. Mason City is the capital of Cerro Gordo county, Ia., and is located in Mason township on Lime creek, at a point about 88 miles north by west of Marshalltown. The Central Railroad of Iowa runs through Mason City, as does the Iowa and Dakota division of the Chicago, Milwaukee and St. Paul Railroad. It sustains several flouring mills, manufactures of pottery, etc., has several substantial buildings, and has a population of about 4,500.

THE proprietors of the Wilkes-Barre (Pa.) Gas Company have awarded a contract for two 6-foot sets of water gas apparatus to the Economical Gas Apparatus Construction Company, Limited, of Toronto, Canada. The contractors will, as it is their custom to do, have all this work manufactured in the United States.

THE Missouri Gas Company, of Kansas City, Mo., has paid into the city treasury the sum of $1,170.38, which sum stands for 2 per cent. on the Company's gross receipts for the six months ended October 31.

MR. O. E. WELLER, as Receiver of the Citizens Gas Light Company, of Reading, South Reading and Stoneham, announces that he will sell at auction, at 3:30 P.M. of the 28th inst., on the Company's premises at Stoneham, all of the properties of the said Company.

ON the 18th inst. Miss Corinne B. Beedle and Mr. Carl H. Graf were united in marriage, the ceremony taking place at the Beneficent Congregational Church, Providence, R. I. The bride is a daughter of Mr. and Mrs. Charles H. Beedle, of Providence, and the groom is a valued attache of the Lawrence (Mass.) Gas Company. Mr. and Mrs. Graf will be at home after January 1st, 1897, in their permanent residence, Logan street, Lawrence.

THE following is the text of the decision of the Massachusetts Board of Gas and Electric Light Commissioners, in respect of the application of the Brookline, Mass., Gas Light Company, for authority to issue $1,000,000 bonds—the Commissioners decided that the issue should be restricted to $425,000, and the Company declined to abide by the decision :

"The application of the Brookline Company was for the approval of an issue of $1,000,000 bonds, the proceeds to be applied to the payment of obligations incurred for the enlargement and extension of its plant and the purchase of real estate for the use of the Company. The Company has now outstanding $2,000,000 capital stock, and $1,000,000 mortgage bonds ; and as a part of its floating debt certificates of indebtness or promissory notes, payable in 2 years, amounting to $1,500,000. The Company desired to use the bonds asked for to pay or fund a portion of these certificates. The structural value of the plant, as appraised by an expert, appears to be in round numbers, $3,300,000. This amount does not include gas stoves in hands of consumers, nor other fixtures, the title to which is seriously in question. The Company's land was appraised at $125,000, making total appraisal, $3,425,000. The books of the Company show expenditures and construction account much larger than this amount. Whether this is due to the expense of running the business in competition with other Companies in Boston, to the enhanced cost of the plant on account of extraordinary conditions attending its construction, or to recent reductions in the cost of materials, the Board has not assumed to decide. Under the policy of the Board this difference should not be represented under capital unless some substantial advantage, such as has not yet appeared, can be secured. The Commissioners, therefore, can approve the issue of only $425,000 thirty-year, 6 per cent., second mortgage bonds."

MESSRS. James N. Rice, William T. Smith, Edward B. Sturges, J. Atticus Robertson and J. Gardner Sanderson, applied to the Governor of Pennsylvania, for a charter for a corporation to be called "The Anthracite Gas Producer Company," the character and object of which are "the manufacturing and distributing of gas for power, fuel and illumination, to erect gas producing plants for others, and to sell and grant rights to use their process for producing gas under their process."

THE plant and franchises of the Consolidated Gas and Electric Light Company, of Westchester county, N. Y., were sold at auction on the 17th inst. The properties were bid in by Charles Perry, of Westerly, R. I., who represented the holders of $123,000 of the Company's first mortgage bonds, the total of which issue amounts to $250,000—there is a second mortgage indebtedness of $100,000. Mr. Perry's bid was $190,200. The Company supplies gas and electric lights in the towns of Portchester, Rye, Mamaroneck, Harrison and Larchmont, N.Y., and it was originally financed by the firm of Coffin & Stanton, of this city, whose failure was recorded some time ago.

JOHN R. BUGG, for many years a trusted employee of the Nashville (Tenn.) Gas Company, is under arrest, charged with misappropriating the Company's funds.

AT a meeting of the Board of Directors of the Johnstown (Pa.) Gas Company, Mr. C. S. Price was elected to the Presidency, vice Mr. James McMillen, deceased. The vacancy in the Board was filled by the election of Mr. Joseph Morgan, Jr.

THE Board of Directors of the Ilion and Mohawk (N. Y.) Gas Light Company have ordered a special meeting of the shareholders for December 4th, for the purpose of voting upon a proposition to increase the capital stock from $30,000 to $50,000.

THE Borough Council of Forty Fort, a suburb of Wilkes Barre, Pa., has granted the West Side Gas Company, of Wilkes-Barre, the right to lay mains through the borough. Under the franchise the Company agrees to supply gas at the rate of $1.50 per 1,000 cubic feet, prompt payment (within 15 days) to entitle the user to a rebate of 10 per cent.

THE Woburn (Mass.) *Journal* says that President Benjamin Hinkley, of the Woburn Gas Light Company, and the local Directors, Messrs. John Johnson, Oliver F. Bryant and Chas. A. Jones, have sold out their entire holdings and resigned their positions in the Company. The purchasers are Col. C. C. G. Thornton and others, of Boston. Mr. Richard J. Monks retains his interest and will continue to act as Treasurer and General Manager of the Company.

THE Board of Gas and Electric Light Commissioners held a hearing last Wednesday on the petition of the Jamaica Plain (Mass.) Company for permission to increase the capital stock in the sum of $100,000.

MR. WARREN B. MASON, President of the Chicago Acetylene Gas and Carbide Company, died at his home in Chicago about a fortnight ago.

MR. PETER DIRVIN, for many years Superintendent of the Healdsburg (Cal.) Gas Light Company, informs us that he has leased the works, and proposes to improve the same.

THE City Council of Phœnix, Ariz., has revoked the franchise (for the operation there of a gas and water works system) granted to Mr. J. J. Gardiner some time ago. The repeal was ordered on the ground that Gardiner had failed to commence construction work within the period agreed upon.

ADVICES from Newport News, Va., are to the effect that the project for the establishment there of a gas plant has been revived. The officers of the concern are : President, I. Eugene White ; Vice-President, M. V. Doughty ; Secretary, Irwin Tucker ; Treasurer, A. W. Post. The Council has been petitioned to grant the necessary franchise, the main features of which are as follows :

First.—Be it ordained by the Common Council of the city of Newport News, Va., that the right, privilege and franchise are hereby granted to the Newport News Gas, Fuel and Power Company to locate and lay its pipes and mains through, along and under the avenues and streets of the city of Newport News, Va., for the purpose of distributing light and fuel and power to the city of Newport News, Va., and its inhabitants, to make the necessary connections with public and private buildings, and to locate and erect necessary posts and other appurtenances, along and on said avenues and streets : *Provided*, That a reasonable price per 1,000 feet for gas shall be charged in the case of private individuals, and for public lights such sum as may be agreed

upon between the said Company and the public authorities of the city of Newport News, Va., not exceeding more per 1,000 feet than the said Company shall be getting at the same time from the inhabitants of said city using said gas.

Second.—That such pipes, mains, connections, posts and other fixtures and appliances shall be located, laid and erected under the supervision of the City Engineer, and according to such rules and regulations and upon such conditions as the Committee on Streets of this Council shall prescribe and determine.

Third.—The said Newport News Gas, Fuel and Power Company shall commence work on its plant within four months from the passage of this ordinance, and complete the same within eight months from the time allowed for starting work, otherwise this franchise to be null and void.

Fourth.—This ordinance shall be in force from its passage.

A CORRESPONDENT at Waltham, Mass., writes that the Board of Aldermen of that city have instructed the special committee, appointed some time ago to consider the advisability of purchasing the plant of the Waltham Gas Light Company for operation on municipal account, to ask the Company to file an inventory of its property with the City Clerk for use in the further discussion of the proposition.

AN explosion occurred some days ago in the purifying room of the Waterville (N. Y.) Gas Light Company. The damage is put at $300.

AT the annual meeting of the Elizabethtown Gas Light Company, of Elizabeth, N. J., the following Directors were elected: Messrs. John Kean, Julian H. Kean, Alexander L. Kean, Hamilton F. Kean and James Maguire.

THE Common Council, of Kansas City, Mo., has adopted an ordinance providing for the appointment of an inspector of gas and gas meters, which measure has been under consideration for several months. The ordinance directs the inspector to test and seal all new meters at the expense of the Company owning them. Meters in use are to be inspected on complaint of consumers. If the test proves them to be correct the expense of the inspection must be borne by the complainant. The ordinance fixes the inspection fee at $1 per meter. The inspector is to have a salary of $1,200 per year, and may have an assistant, at the discretion of the Board of Public Works.

OFFICIAL returns show that the quantity of crude oil distilled by the Canadian refineries during the last year was 25,223,785 imperial gallons, and there was used for fuel 2,213,636 gallons, making a total of 27,437,424 gallons. The quantity of illuminating oil produced was 10,924,826 gallons. The products of the refineries in illuminating and lubricating oils for the year were as follows: Illuminating, 10,924,826 gallons, valued at $1,237,328; lubricating, 2,400,404 gallons, valued at $205,591. It is also shown that the refineries have in the last few years, through improved processes, obtained an augmented supply of illuminating oil from the crude. The proportion of lubricating oil has decreased 2.84 per cent., and that of all the other oils has remained very nearly the same; but the average of all oils extracted from the crude has been raised by 2.53 per cent.

A CORRESPONDENT at Baltimore, Md., forwards the following: "At this time of year heads of families and other consumers of gas begin to awaken to the fact that gas bills are increasing, and they object accordingly; not only so, but they study over plans and schemes to get the better of the Gas Company—of course, in a legitimate way. Mr. W. H. Swindell, the official sealer and inspector of gas meters, says that he is overrun with requests from consumers to test their meters, and by petitions asking for methods to check gas consumption. In response to these queries he caused the publication in the *Baltimore News* of the following plan, as a means of checking gas consumption: 'Light the same number of burners nearest the meter—say in the parlor—that may be used throughout the house at any one time, turning the stop-cock on full at the burners. Then let the gas be turned off slowly and carefully at the stop-cock, outside the meter, until only the supply wanted by the consumer is admitted, thereby reducing the pressure or force by which the gas is supplied by the Company. Have burners carefully cleaned as often as necessary to allow free passage of gas at the lowest pressure that will give sufficient light. By following this idea, I think many consumers of gas will find their bills reduced, while they will have as much light as before. If a consumer thinks his meter is registering too fast, he should bring it to our office, leave a deposit of $1, and have it tested. If it is found all right he loses his dollar; if not, he gets the dollar back, and the Gas Company must put in a new meter."

THE Directors of the Winnepesaukee Gas and Electric Light Company, of Laconia, N.H., have notified the consumers that the price of gas has been advanced to $2.50 per 1,000 cubic feet. The reason given is the higher price that the Company has been obliged to pay for its naphtha supply.

MR. CHARLES H. BLAKE, of the Worcester (Mass.) Gas Light Company, died at his home in Worcester, about a fortnight ago.

SATISFACTORY progress is being made in the construction of the Newark (N.J.) Gas Company's handsome office building, on Broad street and Central avenue. The building will be a notable addition to the office structures of the city.

A CASE has been tried before the Circuit Court, district of Lexington (Ky.), that attracted much attention in Southern gas circles. The complainant was Mrs. Minnie Sizemore, who sued the city of Lexington for $30,000, for the death of her husband, who was killed by an explosion of gas in a cistern at the corner of Limestone and Third streets, Lexington. The cistern had become fouled with gas that escaped from a gas main which had been broken by men employed on sewer work by the city. When other city workmen went on with the task of cleaning the cistern, one of them negligently lighted a match, and the resultant explosion killed Sizemore, who was standing nearby, and the workmen were also sufferers. We have not been advised as to result of the trial.

THE Trustees of Modesto, Cal., have awarded a contract for the public lighting of that place to the Modesto Gas and Electric Light Company.

MR. A. K. QUINN, the clever Superintendent of the Newport (R. I.) Gas Light Company, reports that the output for the year shows a marked gain over the output for 1895. Several gas engines have been put in operation there and notable improvements have been made on the main system, and it is proposed to install an ammonia concentrating plant of modern type.

Acetylene.

M. Brevans asserts that if ordinary acetylene from carbide be passed through a series of three washing flasks containing a solution of sulphate of copper, there is no effect perceptible within three hours; but after 12 hours the first flask contains a black-brown, brilliant precipitate, the quantity of which goes on increasing for as much as eight days. This precipitate explodes on shock, friction, or heating; and it appears to be a mixture of phosphide and silicide of copper, of sulphate of cupro-acetyle, and a variable quantity of acetylide of copper. Its production appears to depend largely on the presence of ammonia in the crude acetylene gas; and it shows that the crude acetylene contains phosphoreted hydrogen and siliciureted hydrogen. The second flask contains a precipitate which is similar in appearance, but less explosive; and the precipitate in the third flask is not explosive. The explosive precipitate in the first flask will explode even under water, as, for example, when we try to rub it off the glass with a glass rod.

As to the explosibility of acetylene, there are two opinions; one that there may be metallic acetylides formed, which act as detonators to the acetylene itself, so that acetylene cannot be used with reservoirs which are capable of being attacked by it; the other, that it can only be exploded when mixed with air, and that the influence of the outside explosions which can set it off cannot travel far through air. In any case, acetylene at a pressure not much exceeding that of the atmosphere is not explosive, though it is explosive at pressures above two atmospheres; so that there is no reason to fear an explosion through flame running back to a reservoir under a very small excess of pressure. Shock alone does not appear to cause explosion of the gas, only of the acetylides. The alleged poisonousness of acetylene—which has not, as yet, given rise to any accident—would appear to be due to the occasional presence of cyanogen compounds, and is not a feature of pure acetylene. The presence of sulphreted hydrogen in acetylene seems to depend on that of sulphide of aluminum in the carbide of calcium; sulphide of calcium may exist in it without forming this impurity. The blocking of gas jets by acetylene flames seems to be due to the formation of phosphoric acid. If oxygen be not present acetylene does not attack copper; the oxide must be formed before the acetylide can be produced.

The Market for Gas Securities.

The market for city gas shares was well sustained during the week, Consolidated scoring a further advance to 167–167½, which were the quotations at noon to-day (Friday.) Important developments in respect of the Company's policy may be looked for at any time. Other city shares are dull and firm save Standard common, which is a trifle under former quotations. Standard preferred, on the other hand, is firmer, and the bonds are also at better figures. The gain in value of the New York and East River securities has also been well maintained.

Brooklyn Union gas is at last week's prices, and a fairly good demand exists for the bonds. Chicago gas is somewhat lower; there is no doubt that it is worth every cent of the reported price. Bay State is at 10½ to 11, and we strongly advise its purchase, for the powerful people now well up in its councils can be trusted to conserve the property rather than to dissipate it. The bonds (firsts) are a decided bargain. Laclede common is weaker, and the preferred is 75 bid. It is easily worth five points more. San Francisco gas is up to 98½ bid. The American Gas Company has declared a semi-annual dividend of 3 per cent., payable December 1st.

Gas Stocks.

Quotations by Cochran & Close, Brokers and Dealers in Gas Stocks.

35 Wall St., New York City.

Nov. 23.

☞ All communications will receive particular attention.

☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$35,430,000	100	166¾	167⅛
Central	500,000	50	150	..
" Scrip	220,000	..	100	.
Equitable	4,000,000	100	205	215
Bonds, 6's	1,000,000	1,000	105	..
" 1st Con. 5's	2,300,000	1,000	114	.
Metropolitan Bonds	658,000	..	108	112
Mutual	3,500,000	100	238	250
" Bonds	1,500,000	1,000	100	102
Municipal Bonds	750,000	.	..	.
Northern	150,000	50	79	80½
" Bonds	150,000	1,000	..	98
New York and East River	5,000,000	100	42	43
Preferred	2,000,000	100	71	72
Bonds 1st 5's	3,500,000	1,000	104	105
" 1st Con. 5's	1,500,000	..	94½	95½
Richmond Co., S. I.	348,650	50	50	..
" Bonds	100,000	1,000	..	..
Standard	5,000,000	100	81	82
Preferred	5,000,000	100	107	110
Bonds, 1st Mortgage, 5's	1,500,000	1,000	109½	..
Yonkers	299,650	50	130	.
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	95	96
" " Bonds (5's)	15 000,000	1,000	105½	106
Bay State	5,000,000	50	10½	11
" Income Bonds	2,000,000	1,000	..	45
Boston United Gas Co.—				
1st Series S. F. Trust	7,000,000	1,000	80	83
2d " " "	3,000,000	1,000		76
Buffalo Mutual	750,000	100	125	..
" Bonds	200,000	1,000	95	100
Central, San Francisco	2,000,000	..	95	..
Chicago Gas Co.	25,000,000	100	76¾	77
Chicago Gas Lt. & Coke Co. Guaranteed Gold Bonds.	7,650,000	1,000	94	94¼
Columbus	1,069,000	..	..	65
1st Mortgage	1,085,000	..	..	96
Consumers, Jersey City	2,000,000	100	75	85
" Bonds	600,000	1,000	99	101
Cincinnati G. & C. Co.	7,000,000	100	200¼	201
Consumers, Toronto	1,600,000	50	184⅛	187
Capital, Sacramento	500,000	50	..	30
Bonds (6's)	150,000	1,000	..	..
Consolidated, Baltimore	1,000,000	100	66	67
Mortgage, 6's	3,600,000	..	107	107⅛
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,490,000	..	..	..
Detroit	4,000,000	..	32	33
" Con. Bonds	4,312,000	..	..	82
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Fort Wayne	2,000,000	..	78	83
" Bonds	2,000,000	..	82	86
Hartford	750,000	25	..	145
Indianapolis	2,000,000	..	125	132
" Bonds, 6's	2,650,000	..	103	105
Jersey City	750,000	20	180	..
Lafayette Gas Co., Ind.	1,000,000	100	82	87
Bonds	1,000,000	1,000	85	90
Louisville	2,570,000	50	..	..
Laclede, St. Louis	7,500,000	100	27¼	28
Preferred	2,500,000	100	75	80
Bonds	9,084,400	1,000	94½	95
Little Falls, N. Y.	50,000	100	..	100
Bonds	25,000	..	..	100
Montreal, Canada	2,000,000	100	200	.
Newark, N. J., Gas Co.	1,000,000	..	93	98
Bonds, 6's	4,000,000	..	123	..
New Haven	1,000,000	25	225	..
Oakland, Cal.	2,000,000	..	52	53¼
" Bonds	750,000	..	..	..
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	20,100,00	1,000	..	108
2d "	2,500,000	1,000	104	105
Peoples, Jersey City	500,000	50	..	175
Paterson, N. J.	.....	25	99	102
Rochester Gas & Elec. Co.	2,150,000	50	..	..
Preferred	2,150,000	50	88	..
Consolidated 5's	2,000,000	..	87½	90
San Francisco, Cal.	10.000,000	100	98¼	98½
St. Paul Gas Light Co.	1,500,000	100	67½	70
1st Mortgage, 6's	650,000	..	84	87
Extension, 6's	600,000	..	..	..
General Mortgage, 5's	2,400,000	..	88	90
Syracuse, N. Y.	500,000	25	..	..
Washington, D. C.	2,000,000	20	250	..
Western, Milwaukee	4,000,000	100	60	65
Bonds, 5's	3,556,000	.	90	93
Wilmington, Del.	500,000	50	180	182

Advertisers' Index.

GAS ENGINEERS.

	Page
Jos. R. Thomas, New York City	841
Wm. Henry White, New York City	839
Fred. Bredel, Milwaukee, Wis	825
Geo. R. Rowland, New York City	839
The Western Gas Construction Co., Fort Wayne, Ind	830
Humphreys & Glasgow, New York City	826
T. G. Lansden, St. Louis, Mo	839
American Gas Co., Phila., Pa	822
David Leavitt Hough, New York City	841

PROCESSES.

Bartlett, Hayward & Co., Baltimore, Md	837
United Gas Improvement Co., Phila., Pa	829
Burdett Loomis, Hartford, Conn	838
National Gas and Water Co., Chicago, Ills	831
Economical Gas Apparatus Construct'n Co., Toronto, Ont.	837
The Western Gas Construction Co., Fort Wayne, Ind	830

GAS WORKS APPARATUS AND CONSTRUCTION.

James R. Floyd & Sons, New York City	840
Continental Iron Works, Brooklyn, N. Y	838
Deily & Fowler, Phila., Pa	840
Kerr Murray Mfg. Co., Fort Wayne, Ind	836
Stacey Mfg. Co., Cincinnati, Ohio	839
Bartlett, Hayward & Co., Baltimore, Md	837
Davis and Farnum Mfg. Co., Waltham, Mass	836
R. D. Wood & Co., Phila., Pa	838
Isbell-Porter Company, New York City	838
Fred. Bredel, Milwaukee, Wis	825
United Gas Improvement Co., Phila., Pa	829
Berlin Iron Bridge Co., East Berlin, Conn	826
National Gas and Water Co., Chicago, Ills	831
Economical Gas Apparatus Construct'n Co., Toronto, Ont.	837
The Western Gas Construction Co., Fort Wayne, Ind	830
Humphreys & Glasgow, New York City	826
Gas Engineering Co., Pittsburgh, Pa	836
American Gas Co., Phila., Pa	822

SCRUBBERS AND CONDENSERS.

G. Shepard Page's Sons, New York City	839
R. D. Wood & Co., Phila., Pa	838
James R. Floyd & Sons, New York City	840
Continental Iron Works, Brooklyn, N. Y	838
Gas Engineering Co., Pittsburgh, Pa	836

REGENERATIVE FURNACES.

Bartlett, Hayward & Co., Baltimore, Md	837
Fred. Bredel, Milwaukee, Wis	825
J. H. Gautier & Co., Jersey City, N. J	834
Parker-Russell Mining and Mfg. Co., St. Louis, Mo	834
Adam Weber New York City	834

TAR AND CARBONIC ACID EXTRACTOR.

G. Shepard Page's Sons, New York City	839

AMMONIA CONCENTRATORS.

Michigan Ammonia Works, Detroit, Mich	819
G. Shepard Page's Sons, New York City	839
Gas Engineering Co., Pittsburgh, Pa	836

GAS METERS.

John J. Griffin & Co., Phila., Pa	800
American Meter Co., New York and Philadelphia	843
The Goodwin Meter Co., Phila., Pa	842
Helme & McIlhenny, Phila., Pa	843
D. McDonald & Co., Albany, N.Y	843
Nathaniel Tufts, Boston, Mass	842
Maryland Meter and Mfg. Co. Baltimore, Md	842
Metric Metal Co., Erie, Pa	842
Keystone Meter Co., Royersford, Pa	820
Buhl Stamping Company, Detroit, Mich	843

PREPAYMENT METERS.

American Meter Co., New York and Philadelphia	843
John J. Griffin & Co., Phila., Pa	800
D. McDonald & Co., Albany, N. Y	843
Helme & McIlhenny, Phila., Pa	843

GAS AND WATER PIPES.

Ohio Pipe Co., Columbus, Ohio	841
M. J. Drummond, New York City	841
R. D. Wood & Co., Phila., Pa	838
Warren Foundry and Machine Co., New York City	841
Donaldson Iron Co., Emaus, Pa	841
Addyston Pipe and Steel Co., Cincinnati, O.	841

PIPE CUTTERS.

Wm. Anderson, East Boston, Mass.	820

STEAM BLOWER FOR BURNING BREEZE.

H. E. Parson, New York City	831

GAS COALS.

Penn Gas Coal Co., Phila., Pa	833
Perkins & Co., New York City	832
Despard Gas Coal Co., Baltimore, Md	833
Westmoreland Coal Co., Phila., Pa	833
Berwind-White Coal Mining Co., New York and Phila.	832

CANNEL COALS.

Perkins & Co., New York City	832

GAS ENRICHERS.

Standard Oil Co., New York City	833
The Sun Oil Co., Pittsburgh, Pa	833

COKE CRUSHER.

C. M. Keller, Columbus, Ind	833

CONVEYING MACHINERY.

C. W. Hunt Company, N. Y. City	820

GAS GAUGES.

The Bristol Co., Waterbury, Conn	820

GAS GOVERNORS.

Connelly Iron Sponge and Governor Co., New York City	841
Isbell-Porter Co., New York City	838
The Wilder Mfg. Co., Phila., Pa	820

SELF-SEALING MOUTHPIECE DOORS.

Isbell-Porter Co., New York City	838
Continental Iron Works, Brooklyn, N.Y	838
G. Shepard Page's Sons, New York City	839

CEMENTS.

C. L. Gerould & Co., Mount Vernon, N.Y	834

RETORTS AND FIREBRICKS.

J. H. Gautier & Co., Jersey City, N. J	834
B. Kreischer & Sons, New York City	834
Adam Weber, New York City	834
Laclede Firebrick Mfg. Co., St. Louis, Mo.	834
Cyrus Borgner, Phila., Pa	834
James Gardner, Jr., Pittsburgh, Pa	834
Henry Maurer & Son, New York City	834
Baltimore Retort and Firebrick Co., Baltimore, Md	834
Parker-Russell Mining and Mfg. Co., St. Louis, Mo	834
Brooklyn Firebrick Works, Brooklyn, N. Y.	834
F. Behrend, New York City	819

INCANDESCENT GAS LAMPS.

Welsbach Commercial Co., Phila., Pa	823

MICA GOODS.

The Mica Mfg. Co., New York City	820

BURNERS.

C. A. Gefrorer, Phila., Pa	838

LAVA GAS TIPS.

D. M. Steward Mfg. Co., Chattanooga, Tenn	819

GAS TUBING.

Wm. M. Crane & Co., New York City	822

PURIFYING MATERIALS.

Connelly Iron Sponge and Governor Co., New York City 831
Greenpoint Chemical Works, Brooklyn, N.Y. 831
Henry W. Douglas, Ann Arbor, Mich 831

EXHAUSTERS.

The P. H. & F. M. Roots Co., Connersville, Ind 828
Isbell-Porter Company, New York City 838
Connelly Iron Sponge and Governor Co., New York City 831

VALVES.

Ludlow Valve Manufacturing Co., Troy, N. Y. 830
Chapman Valve Manufacturing Co., Boston, Mass. 830
R. D. Wood & Co., Phila., Pa. 838
Continental Iron Works, Brooklyn, N. Y. 838
The P. H. & F. M. Roots Co., Connersville, Ind 828
Isbell-Porter Co., New York City 838
The Western Gas Construction Co., Fort Wayne, Ind. 830

ELECTRICAL APPARATUS.

Wm. Henry White, New York City 839

GAS ENGINES.

Otto Gas Engine Works, Phila., Pa. 844
The American Gas Engine Co., Phila., Pa 835
Backus Water Motor Co., Newark, N. J. 819

ENGINES AND BOILERS.

The Hazelton Boiler Company, New York City 820
W. G. & G. Greenfield, East Newark, N. J. 819

PURIFIER SCREENS.

John Cabot, New York City 819

GAS STOVES.

American Meter Co., New York and Philadelphia 827
The Goodwin Meter Co., Phila., Pa. 842
George M. Clark & Co., Chicago, Ills. 825
Maryland Meter and Manufacturing Co., Baltimore, Md. 842
William M. Crane & Co., New York City 822
Keystone Meter Co., Royersford, Pa. 820
A. Weiskittel & Son, Baltimore, Md. 824

CHINA GAS KILNS.

William M. Crane & Co., New York City 822

GASHOLDER PAINT.

New York Marine Paint Co., Poughkeepsie, N. Y 830

GASHOLDER TANKS.

J. P. Whittier, Brooklyn, N. Y. 830

GASHOLDERS.

Bartlett, Hayward & Co., Baltimore, Md. 837
Continental Iron Works, Brooklyn, N. Y. 838
Deily & Fowler, Philadelphia, Pa. 840
Davis & Farnum Mfg. Co., Waltham, Mass. 836
Kerr Murray Mfg. Co., Fort Wayne, Ind 836
Stacey Mfg. Co., Cincinnati, Ohio 839
R. D. Wood & Co., Philadelphia, Pa. 838

BOOKS, ETC.

Scientific Books 840
Field's Analysis 832
Digest of Gas Cases 833
Directory of Gas Companies 841
Practical Photometry 834
Coal Tar Genealogical Tree 832
Management of Small Gas Works 826
Handbook on Gas Engines 841
Gas Flow Computers 824
Hughes' "Gas Works" 824

TO WHOM IT MAY CONCERN.

I have this day sold all my stock in the Gas Engineering Company, of Pittsburgh, Pa., to Samuel Woods, and have no further connection with or interest in said Company.

JAMES GARDNER, JR.

Pittsburgh, Pa., Nov. 16, 1896.

DIVIDEND NOTICE.

OFFICE OF THE AMERICAN GAS COMPANY,
222 S. THIRD ST., PHILA., PA., NOV. 18, 1896.

The Board of Directors of the American Gas Company have this day declared a semi-annual dividend of 3 per cent., or $3 per share, on the Capital Stock of the Company, payable on and after Dec. 1, 1896.

1120-1 MORRIS W. STROUD, Treas.

DIVIDEND NOTICE.

OFFICE OF WELSBACH COMMERCIAL COMPANY,
40 WALL ST., NEW YORK CITY, NOV. 12, 1896.

The Directors have this day declared a quarterly dividend of two (2) per cent. on the preferred stock, payable on Dec. 10, 1896, to stockholders of record at the close of business Nov. 30. The Transfer books of the preferred stock will be closed from Dec. 1 to Dec. 10, both inclusive. Checks will be mailed.

1120-3 EDWARD C. LEE, Treasurer.

WANTED,

One Four-inch or Six-inch Pelouze & Audouin Condenser,

in good condition. EAST RIVER GAS CO.,
1120-tf Long Island City, N. Y.

Position Desired

As Superintendent of Gas Works or Gas and Electric Light works,

By a man 34 years of age. Sixteen years' experience in the manufacture and distribution of Coal Gas as Supt., and four years in the Electric line. Thoroughly competent to take charge of any plant, separately or combined. A practical mechanic, and understands the erection of gas plants and everything pertaining to the business. Not afraid of work. Salary no object until ability is proven. Best of references.
1102-tf Address "M. E. J.," care this Journal.

ENGAGEMENT DESIRED.

Gas Engineer, wishing change of location, would like engagement as Agent, Manager or Superintendent.

Address "J.,"
1114-tf Care this Journal.

FOR SALE.

Hydraulic, Dip, Branch and Ascension Pipes, Mouthpieces and Lids, for four Benches of 5's and for one Bench of 3 Retorts.
Two Coolers, or Air Condensers, each of 150,000 cubic feet capacity.
Multitubular Condenser, shell, 36 in. diameter, with 98 2in. tubes, 10 ft. 6in. long.
D-Shaped Tar Extractor, 8 ft. long, 1 ft. 6 in. deep.
Scrubber, 48 in. diameter, 11 ft. 9 in. high. Three manholes, 11 in. by 15 in.
8-inch Center Seal. Four Purifiers, 8 ft. x 6 ft.

KEY CITY GAS CO.,
1119-tf Dubuque, Iowa.

ELECTRIC LIGHT PLANT FOR SALE.

By the owner, an Electric Light Plant in a good town, with splended prospects, in the South. Good franchise; city contract for lighting. Stock and bonds issued. Splendid chance for any one who can handle the plant, bonds and stock. A Street Railway can also be purchased cheap and added if desired. Part of pay taken in bonds. Address

"A.," Room 12,
1119-4 Inter Ocean Building, Chicago.

For Sale.

A Small Gas and Electric Light Plant,

in a Southern city of 3,800 inhabitants.

Address FORT WAYNE ELECTRIC CORPORATION,
1097-tf Fort Wayne, Ind.

Patent Lava Gas Tips.

UNIFORMITY GUARANTEED.
ALL SIZES AND SHAPES.

D. M. STEWARD MFG. CO.,
CHATTANOOGA, TENN.

F. BEHREND,

SOLE IMPORTER OF THE CELEBRATED

German (Stettin-Didier) Clay Gas Retorts,

BLOCKS, TILES, FIREBRICKS, FIRE CEMENT,
Stettin "Anchor" & "Eagle" Brand Portland Cement
10 & 12 Old Slip, New York.

Utilize Your Gas Liquor.

NO EXTRA LABOR OR OPERATING EXPENSES.

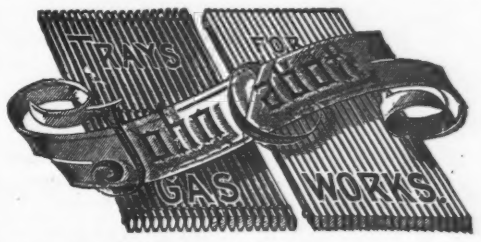
Ammonia Concentrator,

Not Expensive. Write to
STROH & OSIUS, Pat'ees, or
Mich. Ammonia Works, Detroit, Mich.

Special Trays for Iron Sponge or Oxide of Iron.

CHURCH'S TRAYS a Specialty.

Reversible, Strongest, Most Durable, Most Easily Repaired



306-310 Eleventh Avenue, New York.

We also make the Cheapest and Strongest
REVERSIBLE BOLTED TRAYS IN THE MARKET.
Send for Circulars.

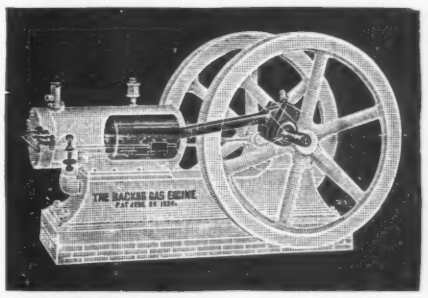
The Gas Engineer's Laboratory Handbook,

BY JOHN HORNBY, F.I.C.

Price, $2.50.

A. M. CALLENDER & CO., 32 Pine Street, N. Y. City.

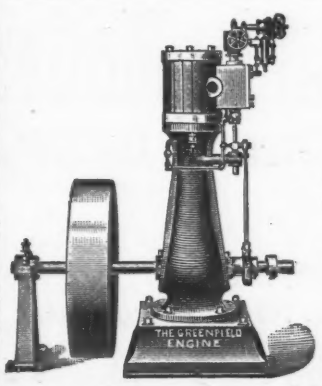
BACKUS GAS ENGINES



GUARANTEED SUPERIOR IN EVERY WAY.
BUILT ON HONOR.

Agts. { Chicago Water Motor & Fan Co., 101 Lake St., Chicago.
Michell & Co., - - 154 Congress Street, Boston, Mass.

Home Office, Backus Water Motor Co., Newark, N. J.
Send for Catalogue.



GREENFIELD Steam Engine Works.

Established 1874.
MANUFACTURERS OF
Greenfield Stationary, Portable and Yacht
ENGINES AND BOILERS.
Also Horizontal, Automatic and Variable Cut-off Engines.
Sizes from 3 to 75 Horse Power.
Also Vertical and Horizontal and Marine Boilers.
Steam Pumps and Adams' Grate Bars.

W. G. & G. GREENFIELD, - - EAST NEWARK, N. J.

THE ANDERSON Patent Cutter Carrying Link
Made in all sizes.
Will cut from 2 in. to 24 in.
Pipe Cutting Tool

For Cutting Cast, Wrought Iron, Gas & Water Pipes.
WM. ANDERSON,
425 Meridian Street,
East Boston, Mass., or
WALDO BROS.,
88 Water Street, Boston, Mass.

On the New York Central

You travel in perfect security, protected every foot of the way by

Block Signals

The Pioneer Vertical Water-Tube Boiler of the World!

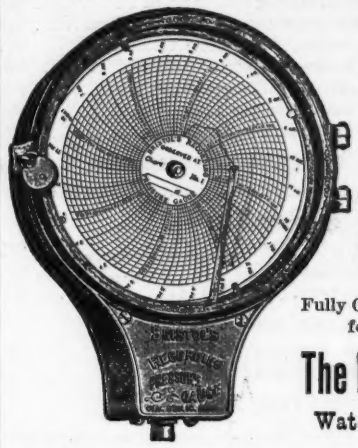
THE HAZELTON OR PORCUPINE BOILER.

After Sixteen Years of Active Service in all the Principal Industries this Boiler has Proven Itself Superior to all Others in Economy o Fuel, Durability, Safety and General Efficiency.

NO EXPLOSIONS OR ACCIDENTS OF ANY KIND.

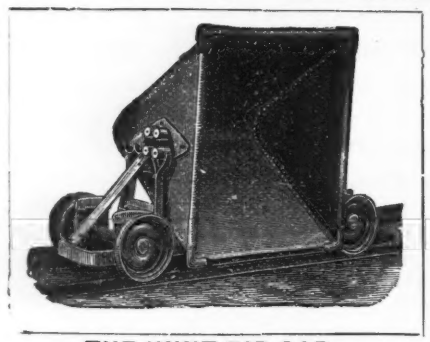
Correspondence Solicited.

The HAZELTON BOILER COMPANY,
Sole Proprietors and Manufacturers,
Cable Address, "Palla," New York.
Tele., "1229-18th St.," New York.
Gen'l Office, 716 E. 13th St., N.Y., U.S.A.



BRISTOL'S RECORDING
PRESSURE GAUGE.
For continuous records of Street Gas Pressure
Simple in Construction, Accurate in Operation, Low in Price.
Fully Guaranteed. Send for Circulars.
The Bristol Co.,
Waterbury, Conn.

G. W. HUNT COMPANY.



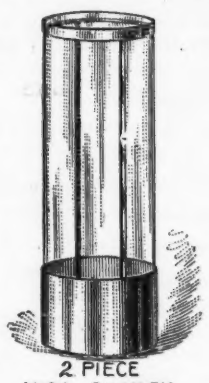
THE HUNT TIP CAR.

COKE CARS for Gas Works,
TIP CARS for Carrying Ashes,
CHARGING CARS for Bringing Coal from the Storage Bins to Boiler Room and Retort Houses.

INDUSTRIAL RAILWAYS
Specially designed for handling material in and around
Gas Works, Coal Yards, Factories, Etc., Etc.

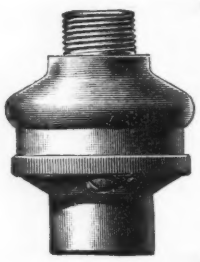
45 BROADWAY, - - NEW YORK.

Our Mica Chimneys



2 PIECE MICA CHIMNEY.
Etched Chimneys to Order.

For Welsbach Lights
ARE THE
BEST IN THE WORLD.
Get Catalog and Discounts.
The MICA MFG. CO
Micasmiths,
88 Fulton Street, N. Y. City.



THE GREATEST IMPROVEMENT IN GAS LIGHTING
Has been made by
WILDER'S VOLUMETRIC GOVERNORS.
They control the pressure at the burner, and deliver the quantity for which they are set regardless of high or low pressure in the supply.
WELSBACH LIGHTS are fully controlled, and the governors soon pay for themselves by preventing the breaking of mantles and chimneys. Thousands are already in use. Orders may be given to the Welsbach Co., or sent to ourselves.
THE WILDER MANFG. CO., - - 818 Cherry St., PHILADELPHIA.

WIESTER & CO., 17 & 19 New Montgomery St., San Francisco, Cal.,
PACIFIC COAST AGENTS FOR THE KEYSTONE METER CO.

Gas Meters and All Apparatus for Measuring and Testing Gas.

REPAIRING, ALL KINDS OF METERS, PROMPTLY, AND SATISFACTION GUARANTEED

Other Agencies and Showrooms:

New York, New Jersey & Connecticut,
THE BARTLETT LAMP MFG. COMPANY,
66 W. Broadway, N. Y. City.

Western,
CAHILL, SWIFT & CO.,
121-207 S. 7th St., St. Louis, Mo.,

Main Office:
ROYERSFORD, PA.

••• A Full Stock ••• All Sizes on Hand ••• At these Points •••

The Gas Exposition.

THE GAS INDUSTRIES COMPANY, INCORPORATED,

Offices, 280 Broadway, New York City.

To be Held at MADISON SQUARE GARDEN, NEW YORK,

Two Weeks, Beginning January 25, 1897.

OFFICERS:

President, PROF. CHARLES F. CHANDLER.

Vice Presidents, THOMAS F. ROWLAND, EMERSON McMILLIN, WALTER WOOD, THOMAS DOLAN, WM. R. BEAL
GEN. ANDREW HICKENLOOPER.

E. C. BROWN, Managing Director. L. J. MONTGOMERY, Secretary. GEORGE W. DOANE, Treasurer.

EXECUTIVE COMMITTEE:

E. C. BROWN, Chairman. EMERSON McMILLIN. COL. W. E. BARROWS. WM. H. BRADLEY. WALTON CLARK.

DIRECTORS:

Dr. Robert Amory, Boston.
Hon. Calvin S. Brice, New York.
Gov. Asa S. Bushnell, Columbus, O.
Wm. R. Beal, New York.
Col. W. E. Barrows, Gloucester, N. J.
Wm. H. Bradley, New York.
E. C. Brown, New York.
Prof. Charles F. Chandler, New York.
Walton Clark, Philadelphia.
Thomas Dolan, Philadelphia.
G. W. Doane, New York.
H. E. Gawtry, New York.
E. P. Gleason, New York.
Alexander C. Humphreys, New York.
Gen. Andrew Hickenlooper, Cincinnati.
Charles E. Judson, Chicago.
Gen. James H. Jourdan, Brooklyn.
John Kean, Elizabeth, N. J.
Emerson McMillin, New York.
Edm'd H. McCullough, Philadelphia.
Dr. Henry Morton, Hoboken, N. J.
Prof. T. C. Mendenhall, Worcester, Mass.
Martin Maloney, Philadelphia.
Wm. J. Murphy, Minneapolis.
Albion L. Page, New York.
Thomas F. Rowland, New York.
Frank Tilford, New York.
Prof. R. H. Thurston, Ithaca, N. Y.
Eugene Vanderpool, Newark, N. J.
Capt. Wm. H. White, New York.
Dr. Wm. H. Wahl, Philadelphia.
Walter Wood, Philadelphia.

The Gas Associations have Appointed the Following Representatives:

W. M. EATON, Michigan Gas Asso. **J. A. BRITTON,** Pacific Coast Gas Asso. **IRVIN BUTTERWORTH,** Ohio Gas Light Asso. **GEO. T. THOMPSON,** Western Gas Asso.

PROSPECTUS.

THE object of the **Gas Exposition** is to bring together a collection of gas apparatus and appliances of every description, for the two-fold purpose of affording the general public and the gas engineer an opportunity to study the developments that have taken place in the gas industry during recent years. In submitting the plan of the Exposition to those who may feel an interest in the project, the management would call the attention of manufacturers of supplies of every description, entering into the manufacture of gas, to the great benefits which similar affairs have conferred on the industries of Great Britain, Germany and France, in which countries the exhibitions of gas appliances are held with recurring frequency. The creation of a healthy public sentiment in favor of gas is one of the first aims of large numbers of foreign gas companies.

MADISON SQUARE GARDEN.

In the selection of New York for the inauguration of an enterprise of this character, it is believed that no mistake has been made. In this city the Madison Square Garden is looked upon as one of the great show places of the metropolis; it contains within its walls the requisite space for the proper display of an almost unlimited amount of product, without which an affair of this kind cannot hope for the stamp of public approval—hence the selection of this great building for the inauguration of the gas industries exposition during the two weeks beginning January 25, 1897.

The greater New York contains a resident population of 3,000,000 people. Within a radius of 50 miles of Madison Square Garden live 4,500,000 people; reliable statistics show that an average of fully 100,000 strangers visit New York every day in the year. Thus it will be seen that the gas exposition will draw from a population of fully 6,000,000. In this connection it ma be stated that every effort will be put forth that ingenuity can devise to thoroughly advertise the exposition, and create a desire in the minds of the public to come to the show; and once within its portals the dazzling brilliancy there abounding, coupled with the many attractive and instructive exhibits, will cause the visitor to wish to come again.

It is expected that cooking demonstrations will be a feature of the exposition. The lecture and concert hall, situated conveniently near the great amphitheater, in which the exposition is to take place, affords seating room for 1,200 to 1,400 people. The most experienced and talented ladies obtainable will be selected for this feature of the affair, which must prove one of the show's greatest attractions; not only for the housewives who may be attracted to it, but for gas managers, who will thus have an opportunity to study the advantages these gas cooking demonstrations offer as one of the means at hand for the education of people in the uses of gas.

THE "VULCAN" GAS HEATERS
And Appliances

No. 234. Design Patented.

Keep Our Catalogue on File.

Take with the Public because they are
Well Made, Well Finished and Well Known.

GAS LOGS, RADIATORS,
CYLINDER STOVES,
FIRE PLACE HEATERS,
IMITATION COAL FIRES,
Everything for Gas
that is made!

Waffle Irons, Cake Griddles,
Hot Closets, Ovens,
Candy Stoves, Water Heaters,
etc., etc.

No. 213.

WM. M. CRANE & CO., 838 Broadway, New York.
Factory, 447 to 453 West Fourteenth Street.

AMERICAN GAS COMPANY,

222 South Third Street, Philadelphia, Pa.

Owns, Operates, Buys and Leases Gas Works.

ALSO UNDERTAKES ALL KINDS OF CONSTRUCTION WORK.

Especially the Installation or Extension of Plants for the Manufacture of Gas from Caking Coal.

The attention of Gas Managers is particularly called to the many improvements in this method of manufacture instituted during the past fifteen years, and the extremely low cost at present of Coal Gas.

CORRESPONDENCE RESPECTFULLY SOLICITED. Address

GEO. G. RAMSDELL, Gen'l Mangr.

INJUNCTION ISSUED AGAINST INFRINGERS.

On September 23d the United States Circuit Court for the Southern District of New York granted an injunction restraining and enjoining the further infringement of our Welsbach patent. READ IT.

UNITED STATES CIRCUIT COURT,
Southern District of New York.

WELSBACH LIGHT COMPANY,
vs.
A. LIEBES.
} IN EQUITY.

The President of the United States,

TO A. LIEBES, and his servants, agents, attorneys and workmen, GREETING:

WHEREAS, It has been represented to us in our Circuit Court of the United States for the Second Circuit and Southern District of New York, that Letters Patent of the United States No. 438,125, were issued in due form of law on the 7th day of October, 1890, to Carl Auer von Welsbach, assignor of the complainant, then known as "Welsbach Incandescent Gas Light Company of New Jersey," and that the complainant herein is the owner of said Letters Patent, and that you, the said A. Liebes, have infringed the rights secured by the aforesaid Letters Patent, by making, using and selling to others to be used, incandescent devices for gas burners, embodying and containing the invention and improvements described and claimed in said Letters Patent No 438,125.

NOW, THEREFORE, We do strictly command and enjoin you, the said A. Liebes, and your attorneys, agents, servants and workmen. under the penalties which may fall upon you in case of disobedience, that you forthwith and forever desist from directly or indirectly making, or causing to be made, delivering, vending, or causing to be sold, offering for sale, using, or causing to be used in any manner, any incandescent devices for gas burners, like, or similar to those which you have heretofore made, used or sold, containing or embodying the invention and improvements described in said Letters Patent No. 438,125, and claimed in the claim thereof, and from counterfeiting or imitating the said invention or improvements or any part or parts thereof, and from in any manner or way whatsoever, violating or infringing the said Letters Patent No. 438,125 and the claim thereof, and from doing, or causing to be done, any other act or thing whatsoever in infringement of the said Letters Patent No. 438,125.

WITNESS, The Honorable Melville W. Fuller, Chief Justice of the United States, at the City of New York, in the Southern District of New York, this twenty-fourth day of September, A. D., 1896.

(SEAL.) JOHN A. SHIELDS, Clerk.

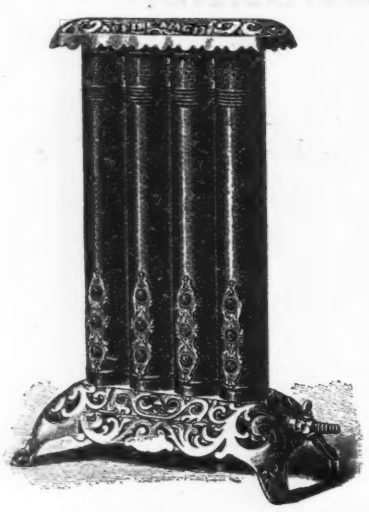
(Endorsed) U. S. Circuit Court, Southern District of New York, in Equity.—Welsbach Light Company vs. A. Liebes. Injunction.

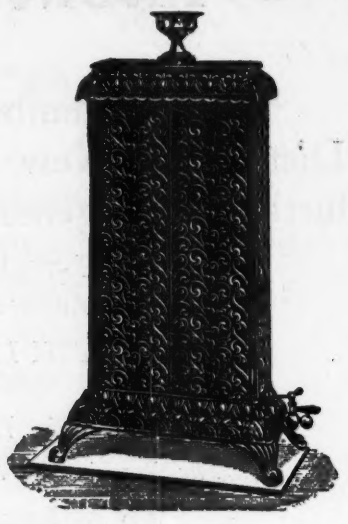
A Copy of a Writ of Injunction this day issued out of my office. JOHN A. SHIELDS, Clerk.

We shall proceed against all infringers; manufacturers, dealers and users being equally liable to injunction and damages. The decree of the court awarding the injunction also awards profits and damages. Do not be misled or deceived by guarantees offered by infringers, as such guarantees will not protect you against suit, injunction and damages. For your own protection see that you get the genuine Welsbach light. All other incandescent gas lights are infringements.

WELSBACH LIGHT COMPANY.

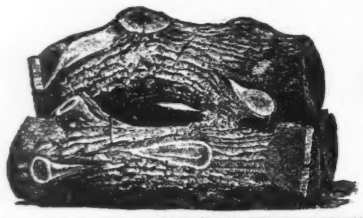
FIRE KING GAS HEATERS.





Best in the World.

Best Constructed, Finest Finished and Most Economical Gas Stoves Made. Send for Beautiful New Catalogue, just issued, and get our Prices before buying.



MANUFACTURED BY

A. WEISKITTEL & SON, Baltimore, Md.

New York Branch, 1387 Broadway.

New England Agents, WALDO BROS., Boston.

HUGHES' "GAS WORKS,"

Their Construction and Arrangement,

And the Manufacture and Distribution of Coal Gas.

Originally written by SAMUEL HUGHES, C.E.

Rewritten and Much Enlarged by WILLIAM RICHARDS, C.E.

Eighth Edition, Revised, with Notices of Recent Improvements. **Price, $1.65.**

A. M. CALLENDER & CO., No. 32 Pine Street, N. Y. City.

A CONVENIENT

BINDER for the JOURNAL

STRONG.

DURABLE.

LIGHT.

SIMPLE

CHEAP.

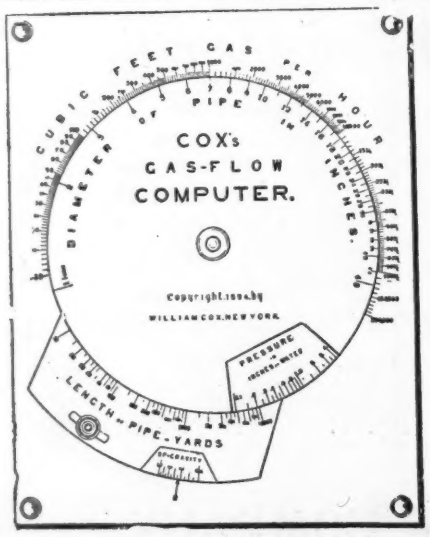
HANDSOME.

Price, $1.

A.M. Callender & Co.,

32 Pine st.,

N. Y. City.



Cox's Gas Flow Computer.

1. It gives at a glance the discharge of gas from pipes 1 to 48 inches in diameter and 10 to 10,000 yds. long, for any pressure from 0.01 to 10.0 inches of water, and any specific gravity from 0.40 to 1.00.

2. When the required discharge and the length of pipe are given, the diameter corresponding to any pressure is at once seen.

3. When the required discharge and the length of pipe are given, the pressure corresponding to any diameter is at once found.

4. Any suitable combination of the different factors of any problem, under all possible conditions, may be immediately found.

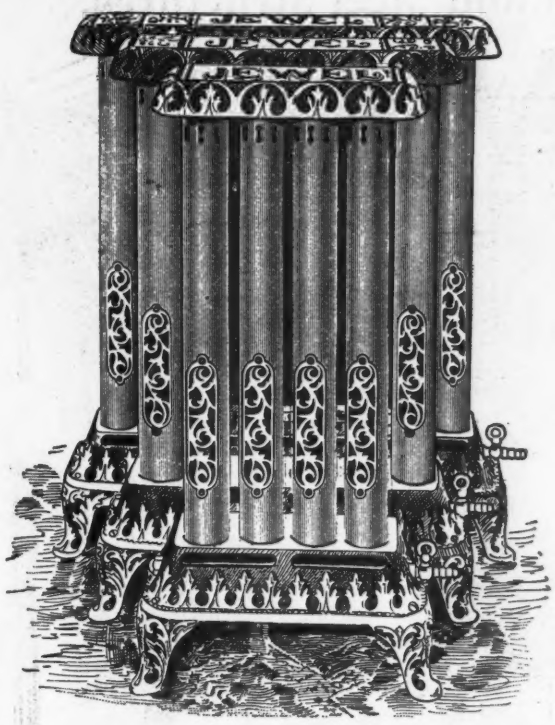
It Prevents Errors and Saves Hours of Tiresome Calculations.

Price, $5.00, per Registered Mail.

For sale by

A. M. CALLENDER & CO., 32 Pine St., N. Y. City.

JEWEL GAS STOVES



For Heating and Cooking,

ARE ABSOLUTELY PERFECT.

60 Styles of Heaters.

78 Styles of Cookers.

This cut illustrates the new line of Radiators. Three Sizes. Two Styles of Finish.

LOW PRICED. VERY HANDSOME.

Write for Catalog.

GEORGE M. CLARK & COMPANY, Makers, CHICAGO.

FRED. BREDEL, C.E.

Coal and Water Gas Plants,

OWN SYSTEM.

Recuperative Furnaces, Washers, Condensers, Purifiers, Purifying Machines.

Gas Enriching Plants to Enrich Coal Gas up to 24 Candle Power, and Making a White, Bright, Non-smoking Gas.

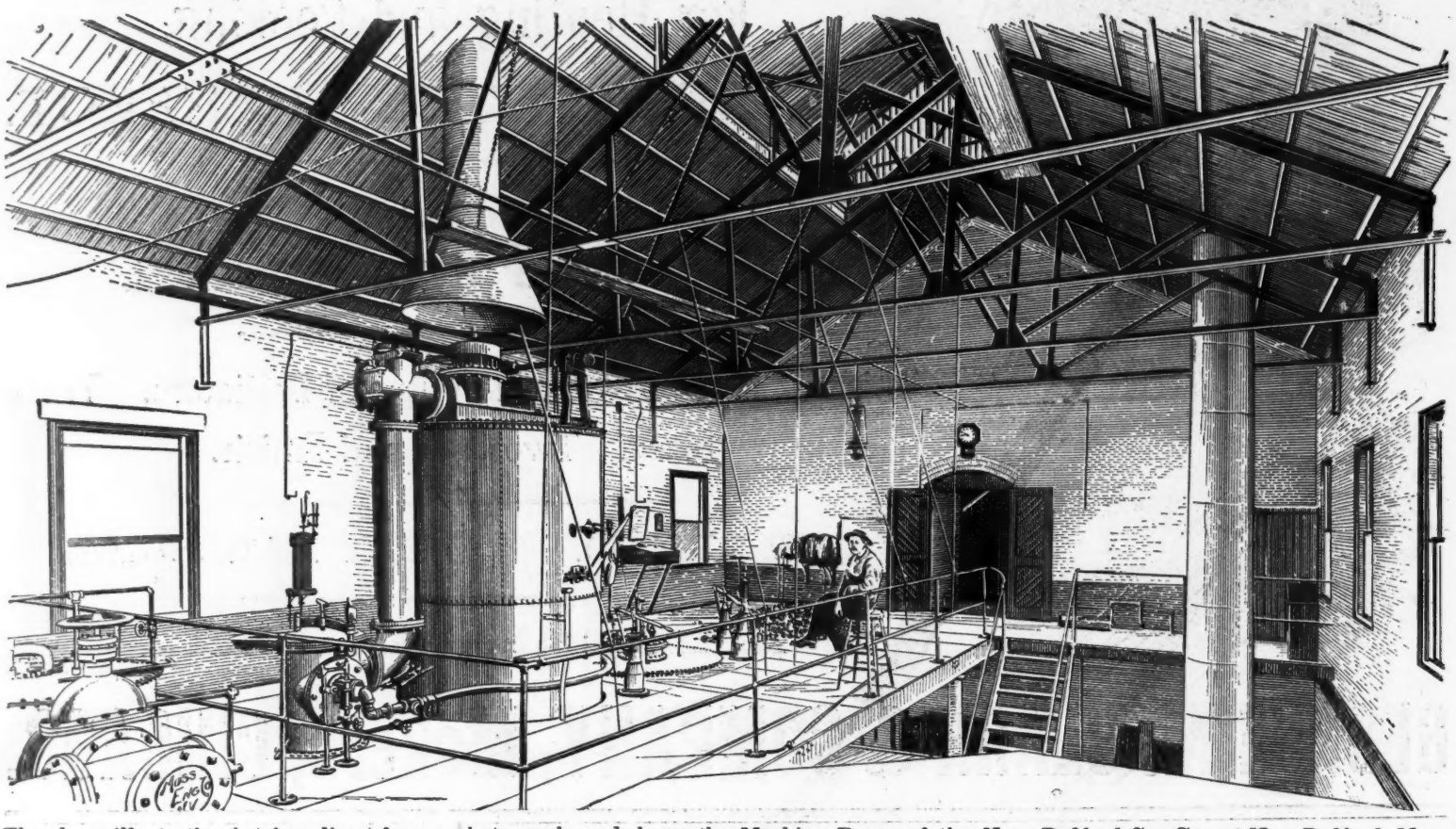
COMPLETE GAS WORKS, COKE CONVEYERS, ETC.

No. 118 Farwell Avenue, · · Milwaukee, Wis.

CHAS. M. JARVIS, Prest. & Chief Engineer. BURR K. FIELD, Vice-President. GEO. H. SAGE, Secretary. FRANK L. WILCOX, Treasurer.

THE BERLIN IRON BRIDGE CO.

Engineers, Architects, and Builders of Iron and Steel Structures.



The above illustration is taken direct from a photograph, and shows the Machine Room of the New Bedford Gas Co., at New Bedford, Mass. The Roof of this building was furnished by us. The building is 32 feet wide by 150 feet long, the Roof being made entirely of iron—that is, iron trusses and iron purlins covered with corrugated iron. The room is ventilated by a wrought iron ventilator extending the full length of the building, with corrugated Iron shutters on each side opening and closing by cords from the floor.

Write for Illustrated Catalogue.

Office and Works, No. 6 Railroad Avenue, East Berlin, Conn.

ALEX. C. HUMPHREYS, M.E., MANHATTAN LIFE BUILDING, (64 BROADWAY,) NEW YORK.

CABLE ADDRESS, LONDON & NEW YORK, "HUMGLAS."

ARTHUR G. GLASGOW, M.E., 9 VICTORIA ST., LONDON, S. W., ENGLAND.

HUMPHREYS & GLASGOW,

CONTRACTING AND CONSULTING

GAS ENGINEERS.

WATER GAS PLANT A SPECIALTY.
GAS PROPERTIES EXAMINED AND VALUED.
ADVICE AS TO IMPROVEMENT OF GAS PROPERTIES AND MANAGEMENT.

THE MANAGEMENT OF SMALL GAS WORKS.

By C. J. R. HUMPHREYS.

Price $1.

A. M. CALLENDER & CO., No. 32 Pine Street New York.

(Copyrighted, 1894, by the AMERICAN METER CO.

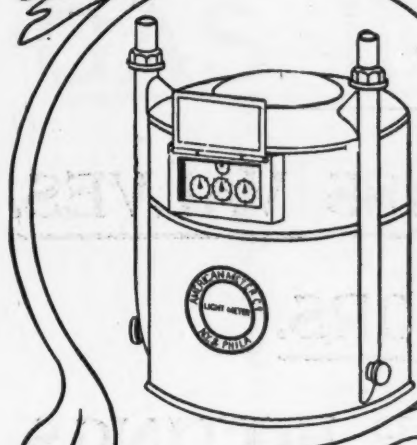
AMERICAN METER CO.

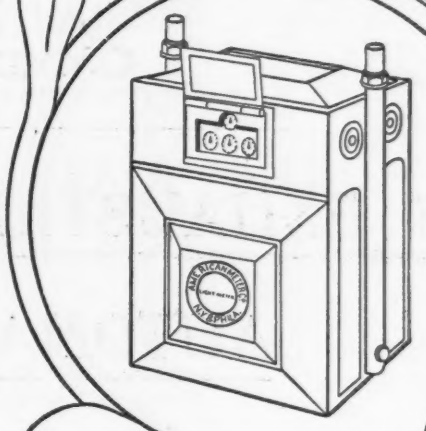
ESTABLISHED 1834. INCORPORATED 1863.

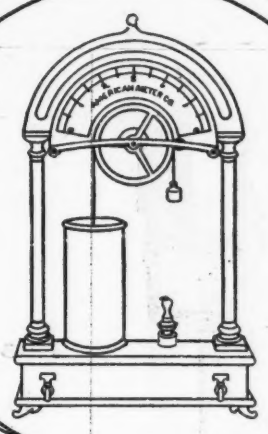
NEW YORK AND PHILADELPHIA,

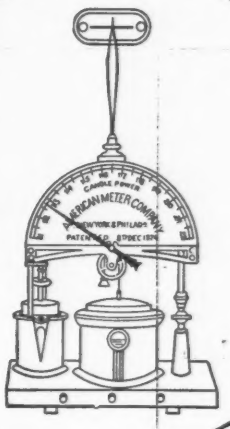
CHICAGO, ST. LOUIS,

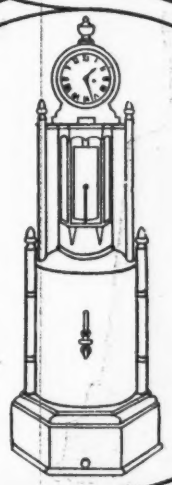
SAN FRANCISCO.

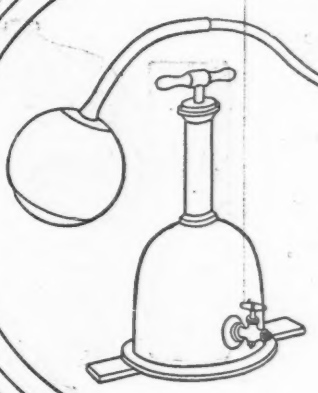


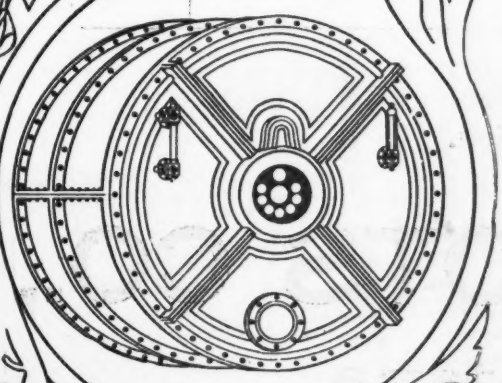


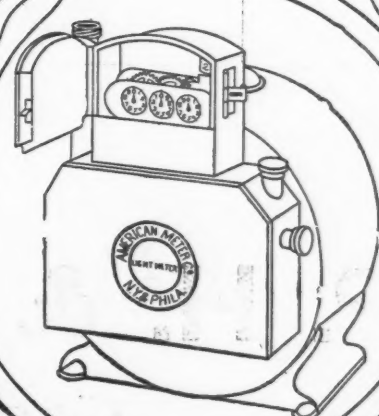












PUBLIC LIGHTING TABLE.

DECEMBER, 1896.

Day of Week.	Date.	Table No. 1. Following the Moon. Light.	Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Extinguish.
				P.M.	A.M.
Tue.	1	5.00 PM	6.10 AM	4.20	6.10
Wed.	2	5.00	6.10	4.20	6.10
Thu.	3	5 00	6.10	4.20	6.15
Fri.	4	5.00 NM	6.10	4.20	6.15
Sat.	5	5.00	6 10	4.20	6.15
Sun.	6	5.00	6.10	4.20	6 15
Mon.	7	5.00	6.10	4.20	6.15
Tue.	8	5.00	6.10	4.20	6.15
Wed.	9	9.00	6.10	4.20	6.15
Thu.	10	10.00	6.10	4.20	6.20
Fri.	11	11 00 FQ	6.10	4.20	6.20
Sat.	12	12.00	6.10	4.20	6.20
Sun.	13	1.00 AM	6.20	4.20	6.20
Mon.	14	2.00	6.20	4.20	6.20
Tue.	15	3.00	6.20	4.20	6 20
Wed	16	4.10	6.20	4.20	6.20
Thu.	17	5 10	6.20	4.20	6.20
Fri.	18	No L.	No L.	4.20	6.20
Sat.	19	No L. FM	No L.	4.20	6.20
Sun	20	No L.	No L.	4.20	6.20
Mon.	21	5.10 PM	7.00 PM	4.20	6.20
Tue.	22	5.10	8.10	4.20	6 20
Wed.	23	5.10	9.20	4.20	6.20
Thu.	24	5.10	10.30	4.20	6 25
Fri.	25	5.10	11.40	4.20	6.25
Sat.	26	5.10 LQ	12.50 AM	4.20	6.25
Sun.	27	5.10	2.00	4.20	6 25
Mon.	28	5.10	3.20	4.20	6.25
Tue.	29	5.10	4.30	4.20	6.25
Wed.	30	5.10	6.20	4.20	6.25
Thu.	31	5.10	6.20	4.20	6.25

TOTAL HOURS LIGHTING DURING 1896.

By Table No. 1.	Hrs.Min.	By Table No. 2.	Hrs.Min.
January	220.40	January	423.20
February	207.00	February	367.40
March	193.00	March	355.35
April	174.10	April	298.50
May	164.00	May	264.50
June	142.10	June	234.25
July	142 10	July	243.45
August	150.50	August	280.25
September	163.00	September	321.15
October	193.10	October	374.30
November	207.00	November	401.40
December	237.30	December	433.45
Total, yr.	2194.40	Total, yr.	4000.00

P. H. & F. M. ROOTS CO.,

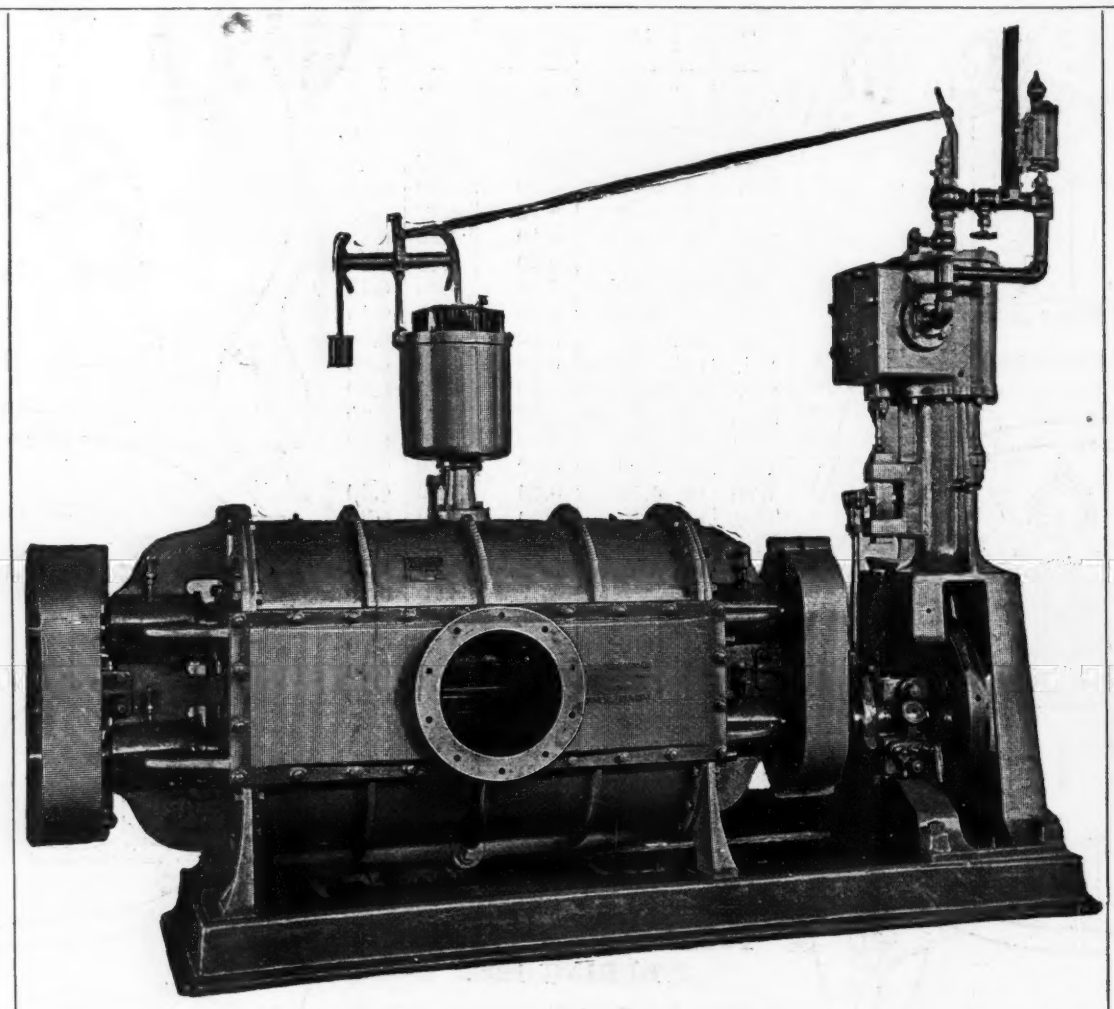
Connersville, Ind.

GAS EXHAUSTERS. BYE-PASS VALVES.

AUTOMATIC GAS GOVERNORS.

GAS VALVES. PIPE FITTINGS.

New Design of Direct Connected Engine and Exhauster on Same Bedplate.



This Design is Used for all Exhausters from No. 7 to No. 10, Inclusive.

Write for Illustrated Catalogue.
Estimates submitted on application.

P. H. & F. M. ROOTS CO.,

Connersville, Indiana.

New York Office, 109 Liberty Street, J. B. STEWART. Manager.

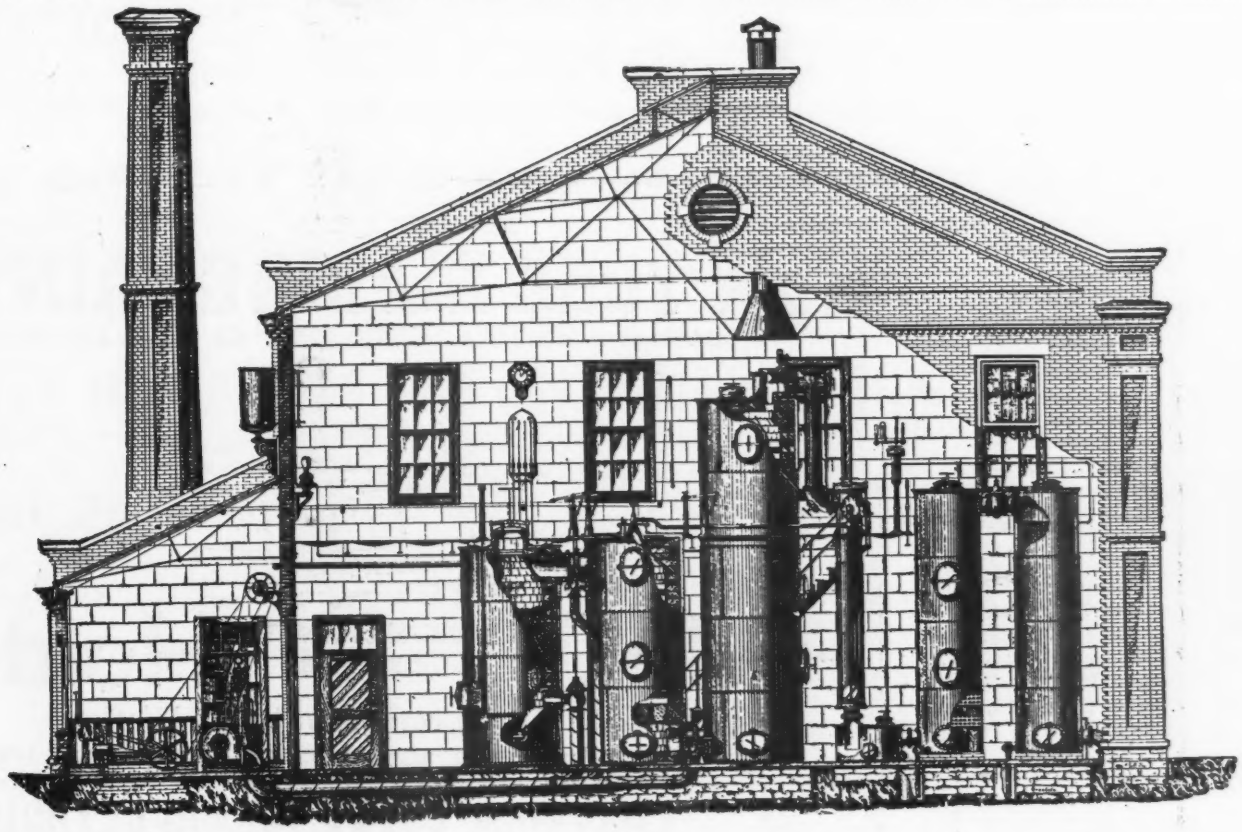
THE UNITED GAS IMPROVEMENT CO.,

DREXEL BUILDING, PHILA., PA.

Inquiries from any part of the United States should be addressed to the Philadelphia Office.

BUILDERS OF

THE STANDARD LOWE WATER GAS APPARATUS.



Standard "Double Superheater" Lowe Apparatus, designed for the use of Naphtha, Crude Oil, or "Distillates."

BUILDERS, LESSEES AND PURCHASERS OF GAS WORKS.

Water Gas Plants, either independent or auxiliary to Coal Gas Works, erected to meet any conditions. Apparatus designed to use any grade of Oil, and Anthracite Coal, or Gas House or Oven Coke.

PAMPHLETS, PLANS AND ESTIMATES FURNISHED UPON APPLICATION.

THE WESTERN GAS CONSTRUCTION CO.,

ENGINEERS and BUILDERS,

FORT WAYNE, INDIANA.

Water Gas Apparatus . . .

Improved Double Superheater Settings,
Improved Single Superheater Settings,
Special Designs for Small Works.

Our apparatus is designed to use any grades of Oils or Naphthas, Gas House or Oven Coke, or Anthracite Coal. Results are Guaranteed.

Coal Gas Apparatus . . .

Agents and Builders. { **For FRED. BREDEL—Washers and Purifying System, Mouthpieces and Bench Castings,**
For GEO. SHEPARD PAGE'S SONS—Walker Ammonia Concentrators and Sulphate Stills, Walker Patent Mouthpieces.

Manufacturers of **THE WESTERN GAS VALVE,** all Iron, Double Gate, 4 to 36 Inch.

Purifiers, Condensers, Scrubbers, Street Main Specials, Iron Roofs, Iron Floors, Oxide Elevators and Conveyer Machinery.

NEW YORK OFFICE, 32 Pine Street, WM. HENRY WHITE, Engr.

THE

LUDLOW VALVE MFG. CO.

MANUFACTURERS OF

VALVES,

Double and Single Gate, ½ in. to 72 in., outside and inside Screws. Indicator, etc., for Gas, Water, Steam, Oil and Ammonia.

SEND FOR CIRCULAR.

SEND FOR CIRCULAR.

ALSO,

Hydraulic Main Dip Regulators, Check Valves, Foot Valves, Yard Wash and Fire Hydrants.

OFFICE AND WORKS:
938 to 954 River St., & 67 to 83 Vail Av., TROY, N. Y.

NEW YORK MARINE PAINT CO.

Successors to TRACY & HADDEN.

TRADE MARK
MANUFACTURERS OF

PAINT PECULIARLY ADAPTED TO STAND ON Holders

And all Ironwork about Gas Works.

POUGHKEEPSIE, N. Y.

CHAPMAN VALVE MANUFACTURING CO.,

MANUFACTURERS OF

Valves and Gates for Gas, Ammonia, Water, Etc.

Also, Gate Fire Hydrants with and without Independent Nozzle Valve. All Work Guaranteed.

Works & Gen'l Office, Indian Orchard, Mass. Treasurer's Office, 72 Kilby & 112 Milk Sts., Boston, Mass.
Chicago Office, 24 West Lake St. New York Office, 28 Platt St.
St. Louis Office, L. M. Rumsey Mfg. Co., 810 North Second St.

GASHOLDER TANKS AND GAS WORKS MASONRY COMPLETE

Plans prepared and Estimates furnished at short notice.

J. P. WHITTIER,

70 Rush St., Near Division Ave., **Brooklyn, N. Y.**

Cincinnati, Indianapolis and St. Louis

Reached quickest and most comfortably by the superb

Southwestern Limited of the New York Central.

NATIONAL GAS AND WATER CO.,

218 La Salle Street, Chicago.

Builder and Operator of Gas Works.

The Rew Soft Coal Carbureted Water Gas Apparatus.

TESTED BY THREE YEARS' PRACTICAL OPERATION, AND FULLY GUARANTEED.

Plans and Estimates Upon Application.

IRWIN REW, President and Treasurer. E. E. MORRELL, Engineer.

CONNELLY IRON SPONGE AND GOVERNOR CO.,

(Successors to CONNELLY & CO.)

MANUFACTURERS OF GAS WORKS SPECIALTIES.

"IRON SPONGE." Saves money, saves labor, and is the most efficient purifying material ever offered as a substitute for lime. We guarantee a large saving, both in cost of material and labor.

AUTOMATIC GOVERNOR.

OVER FOUR HUNDRED NOW IN USE! NO WORKS COMPLETE WITHOUT IT!
WILL PAY FOR ITSELF WITHIN A YEAR! ITS SERVICE SECURES PERFECT DISTRIBUTION!
REDUCES LEAKAGE TO MINIMUM, and BENEFITS THE COMPANY and CONSUMER ALIKE!
IT IS THE ONLY RECOGNIZED AUTOMATIC GOVERNOR IN THE WORLD!

STEAM JET EXHAUSTER. Designed particularly for small works. Combines Exhaust Tube, Steam Governor, Gas Compensator and Bye-Pass Valves in the most compact form possible. Occupies but little space; uses very little steam; saves formation of carbon in retorts; increases yield 10 to 15 per cent. No works too small to use them profitably.

Prices given on all our specialties, delivered at any point in the United States. Correspondence solicited.

CONNELLY IRON SPONGE AND GOVERNOR CO., No. 365 Canal St., New York.

Practical Photometry.

A GUIDE TO THE STUDY OF THE MEASUREMENT OF LIGHT.

By William Joseph Dibdin.

Price, $3.00.

A. M. CALLENDER & CO.,
32 Pine Street, N. Y. City.

BOOKS.

DISTILLATION OF COAL TAR AND AMMONIACAL LIQUOR.
By GEORGE LUNGE. Price $12.50.

TREATISE ON THE COMPARATIVE COMMERCIAL VALUES OF GAS COALS AND CANNELS.
By DAVID A. GRAHAM. 8vo., Cloth. Price $3.

Orders for these books may be sent to this office.

A. M. CALLENDER & CO.,
PINE ST., N. Y. CITY

DOUGLAS' FERRIC OXIDE

For Gas Purification

Is a superior natural Hydrated Oxide of Iron. Will give a higher purification per bushel than any other material. We ship the pure Oxide of Iron, containing no sawdust, thus effecting a saving in freight, leaving the consumer to furnish the diluent at a nominal cost. It is now used by the largest gas companies in the West.

Full information, with references to many users, and prices delivered in any locality, furnished on application to

H.W. Douglas (Supt. Ann Arbor Gas Company) **Ann Arbor, Mich.**

IRON MASS

For Gas Purification.

Acts immediately, and more efficiently than any other purifying agent now in use.

Greenpoint Chemical Works.

JOHN SCHRIEVER, Manager.

Greenpoint Ave. & Newtown Creek, Brooklyn N.Y.

Parson's Steam Blower,

FOR IMPROVING BAD DRAUGHT IN BOILERS, AND FOR BURNING BREEZE OR OTHER WASTE MATERIAL.

PARSON'S TAR BURNER.

FOR UTILIZING COAL TAR AS FUEL.

PARSON'S AIR JET TUBE CLEANER.

FOR CLEANING BOILER TUBES.

These devices are all first-class. They will be sent to any responsible party *for trial*. No sale unless satisfactory. Manufactured by the WATERTOWN STEAM BLOWER COMPANY

H. E. PARSON, Supt., 621 Broadway, N. Y.

JAMES D. PERKINS. **PERKINS & CO.,** F. SEAVERNS.

228 and 229 Produce Exchange, New York City.

TIDEWATER SALES AGENTS FOR THE FOLLOWING:

Ocean Mine Youghiogheny Gas Coal,

Clinch Valley, Thacker & Logan Gas Coals

Old Kentucky Shale and O. K. Boghead.

Shipments from New York, Philadelphia, Baltimore and Norfolk.

BERWIND-WHITE COAL MINING COMPANY'S

Ocean Westmoreland Gas Coal.

Offices:
Washington Building, New York.
Betz Building, Philadelphia.

STRICTLY High Grade. . . . .
Carefully prepared.
For Gas Making or
Heavy Steaming.

FIELD'S ANALYSIS

For the Year 1895.

An Analysis of the Accounts of the Principal Gas Undertakings in England, Scotland, and Ireland. Being the Twenty-seventh Year of Publication. Compiled and Arranged by

JOHN W. FIELD, Sec. & Gen. Mangr. of The Gas Lt. & Coke Co., London.

Price, $5. For Sale by

A. M. CALLENDER & CO., - No. 32 Pine Street, N. Y. City.

Coal Tar Genealogical Tree

MR. T. VINER CLARKE, of London, Eng., having compiled a novel Chart or Map illustrating the various

CHEMICAL PRODUCTS DERIVED FROM COAL AND COAL TAR,

In the form of a Genealogical Tree, including all the products discovered to date (the total number amounting to near 700), offers for sale a limited number of copies in Colors, mounted on Linen, with Rollers. Price, $3.50. Orders may be sent to

A. M. CALLENDER & CO., - - No. 32 Pine Street, New York.

GAS ENRICHERS. GAS COALS. GAS COALS.

The Despard Gas Coal Co.,

MINERS AND SHIPPERS OF

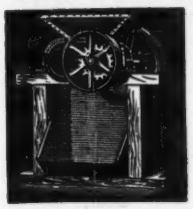
DESPARD GAS COAL,

AND MANUFACTURERS OF

COKE.

MINES, - - Clarksburgh, Harrison Co., West Va.
WHARVES, - - - Locust Point, Baltimore, Md.
OFFICE, - - - 44 South Street, Baltimore, Md.

ROUSSEL & HICKS, 71 Broadway, N. Y. } AGENTS, { BANGS & HORTON 60 Congress St., Boston.



KELLER ADJUSTABLE COKE CRUSHER.

Strong, Simple, Durable. Will Crush any Size Desired.

C. M. KELLER,
Sec. & Supt. Gas Lt. & Coke Co.,
Columbus, Ind.
Correspondence Solicited.

The Gas Engineer's Laboratory Handbook.

BY JOHN HORNBY, F.I.C. Price, $2.50.

A. M. CALLENDER & CO., 32 PINE ST., N. Y. CITY

GREENOUGH'S

"DIGEST OF GAS CASES."

Price, $5.00.

This is a valuable and important work, a copy of which should be in the possession of every gas company in the country, whether large or small. As a book of reference it will be found invaluable. It is the only work of the kind which has ever been published in this country, and is most complete. Handsomely bound. Orders may be sent to

A. M. CALLENDER & CO., 32 Pine St., N. Y.

— THE —

PENN GAS COAL CO.

OFFER THEIR

Coal, Carefully Screened and Prepared for Gas Purposes.

Their property is located in the Youghiogheny Coal Basin, near Irwin and Penn Stations on the Pennsylvania Railroad, and on the Youghiogheny River.

Principal Office:

Room 720, Reading Terminal Building, Phila., Pa.

Points of Shipment:

Pennsylvania Railroad Piers; Greenwich Wharves, Delaware River; Pier No. 1 (Lower Side), South Amboy, N. J.

EDMUND H. MCCULLOUGH, Prest. CHAS. F. GODSHALL, Treas. H. C. ADAMS, Sec.

THE WESTMORELAND COAL CO.

Chartered 1854.

Mines situated on the Pennsylvania and the Baltimore and Ohio Railroads, in Westmoreland County, Pa.

POINTS OF SHIPMENT:

PHILADELPHIA, BALTIMORE, SOUTH AMBOY, N. J.,
WATKINS (SENECA LAKE), N. Y.

Since the commencement of operations by this Company its well-known Coal has been largely used by the Gas Companies of New England and the Middle States, and its character is established as having no superior in gas giving qualities, and in freedom from sulphur and other impurities.

Principal Office, 224 South 3d St., Phila., Pa.

THE SUN OIL CO.,

OHIO CRUDE OIL,

38 to 41 Degrees Gravity.

Toledo, O., and Pittsburgh, Pa.

Standard Oil Company,

GAS NAPTHA DEPARTMENT.

GAS NAPTHA.

GAS OIL.

Correspondence Solicited.

26 Broadway, New York City

RETORTS AND FIRE BRICK. RETORTS AND FIRE BRICK. RETORTS AND FIRE BRICK.

Established 1858. Incorporated 1890.

CHAS. E. GREGORY, Prest. DAVID R. DALY, V.-Prest. & Treas.
H. D. ABERNETHY, Sec.

J. H. Gautier & Co.

Greene & Essex Streets,
Jersey City, N. J.

MANUFACTURERS OF

CLAY GAS RETORTS, FIRE CLAY TILES,
FIRE BRICK and FIRE CLAY SPECIALTIES.

Ground Fire Clay, Fire Sand and Ground Fire Brick in Barrels and Bulk.

SOLE MANUFACTURERS OF THE

FLEMMING GENERATOR GAS FURNACE

Brooklyn Fire Brick Works,

MANUFACTURERS OF

CLAY RETORTS, FIRE BRICK,
Gas House and other Tile.

Office, 88 Van Dyke St., Brooklyn, N. Y.

Established 1854. Incorporated 1869.

LACLEDE
Fire Brick Manufg. Co.,

Manufacturers of { GAS RETORTS . .
FIRE BRICK . . .
RETORT SETTINGS

Water Gas Cupola Linings, Fire Clay, Etc.

Exclusive Agents for

The Mitchell Half-Depth Regenerative Furnace.

This is the *original* coal-consuming Furnace for Retort Benches. Burns either Coal or Coke. Full and Half-Depth Regenerative Furnaces for Benches of 6's, 7's, 8's or 9's erected complete.

Proprietors of the Coze System of Inclined Retorts.

Office: 901 Pine St., **St. Louis, Mo.**

ESTABLISHED IN 1845.

B. KREISCHER & SONS,

Office, 119 E. 23d St., New York.

Gas Retorts,

TILES, FIRE BRICK.

AND EVERYTHING IN THE FIRE CLAY LINE.

Adam Weber,

Proprietor,

Manhattan Fire Brick and Enameled Clay Retort Works.

Works, Weber, N. J.

Office, 633 East 15th St., New York.

Modern Recuperative Furnaces

And Standard Fire Brick and Gas Retorts.

Works, LOCKPORT STATION, PA.

—ESTABLISHED 1864.—

JAMES GARDNER, JR.,

Successor to WILLIAM GARDNER & SON.

Conestoga Bldg., Wood & Water Sts. PITTSBURGH, PA. P. O. Box 373.

Fire Clay Goods for Gas Works.

SOLE REPRESENTATIVE OF THE McILHENNY REGENERATIVE BENCHES FOR THE U. S.

HENRY MAURER & SON,

(ESTABLISHED 1856.)

EXCELSIOR FIRE BRICK & CLAY

RETORT WORKS

WORKS, Perth Amboy, N. J.
OFFICE, 418 to 422 East 23d St., N. Y

Clay Gas Retorts,

BENCH SETTINGS,

Fire Brick, Tiles, Etc.

GEROULD'S IMPROVED RETORT CEMENT

A cement of great value for patching retorts, putting on mouthpieces, making up all bench-work joints, lining blast furnaces and cupolas. This cement is mixed ready for use. Economic and thorough in its work. Fully warranted to stick.

PRICE LIST.

In Casks, 400 to 800 pounds, at 5 cents per pound.
In Kegs, 100 to 200 " " 6 " "
In Kegs less than 100 " " 7 " "

C. L. GEROULD & CO.,

N. 3d & Prospect Avs., Mt. Vernon, N.Y.

Western Agent, H. T. GEROULD, Centralia, Ills.

Parker-Russell Mining and Mfg. Co.,

CITY OFFICE,
417 Pine Street, St. Louis, Mo.

PROPRIETORS OF THE

OAKHILL GAS RETORT & FIRE BRICK W'KS

Our immense establishment is now employed almost entirely in the manufacture of

Materials for Gas Companies

We have studied and perfected three important points. Our retorts are made to stand changes of temperature, the strongest heats of the furnace, and the abrasion of feeding and emptying. We construct

Half and Full Depth Benches of Our Own Design,

Containing 6, 8 or 9 Retorts.

We have Greatly Improved our Recuperators. Coal or Coke can be used as Fuel in Furnaces.

THEO. J. SMITH, Prest. J. A. TAYLOR, Sec'y.
A. LAMBLA, Vice-Prest. and Supt.

BALTIMORE

RETORT & FIRE BRICK CO.

MANUFACTORY AT

LOCUST POINT BALTIMORE MD.

Clay Retorts, Blocks & Tiles

FIRE BRICK, FIRE CLAY,
AND FIRE CEMENT.

Red and Buff Ornamental Tiles and Chimney Tops. Baker Oven Tiles 12x12x2 and 10x10x2.

WALDO BROS., 88 WATER ST., BOSTON, MASS

Sole Agents for New England States.

PRACTICAL PHOTOMETRY.

A Guide to the Study of the Measurement of Light.

By WILLIAM JOSEPH DIBDIN.

With Numerous Illustrations Price, $3.00. A. M. CALLENDER & CO 32 Pine Street, N. Y. City

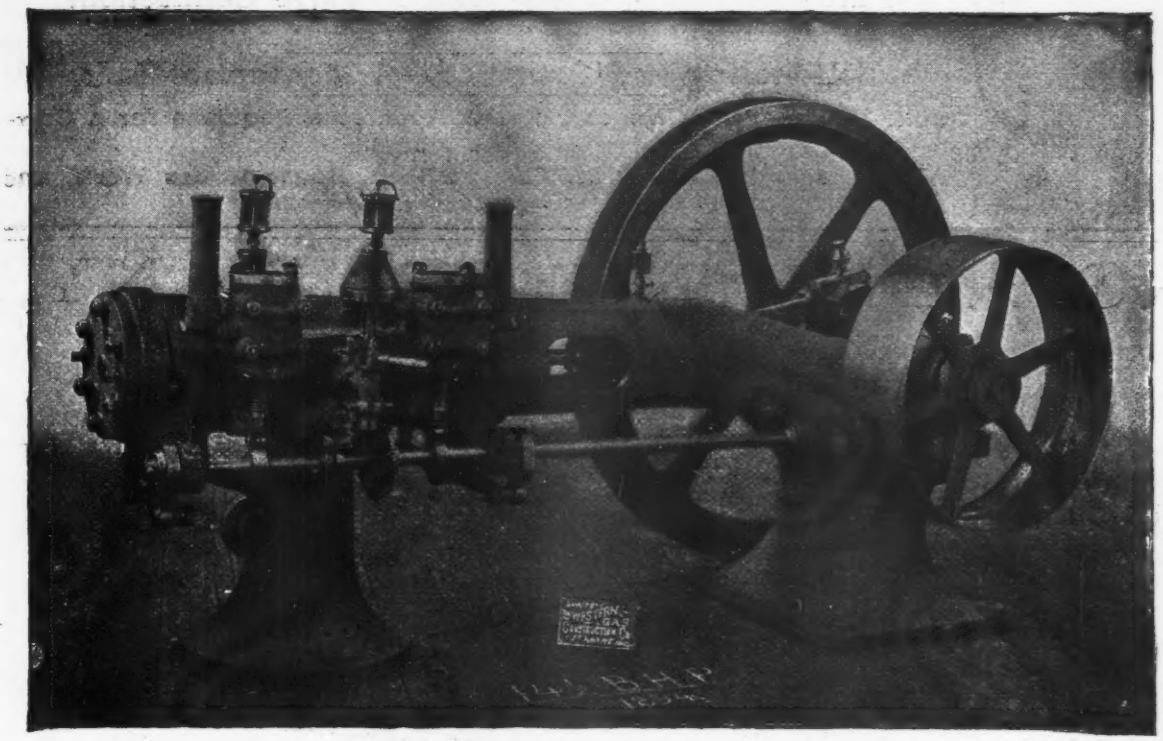
WM. W. GOODWIN, Prest. O. N. GULDLIN, V.-Prest. & Treas. H. B. GOODWIN, Sec. ERNEST F. LLOYD, Asst. Sec

THE AMERICAN GAS ENGINE CO.,

MANUFACTURERS OF

The Double-Acting Gas Engine,

Under the Patents of Griffin, and Dick, Kerr & Co., of London and Kilmarnock.



Single Cylinder.

Impulse Every Revolution.

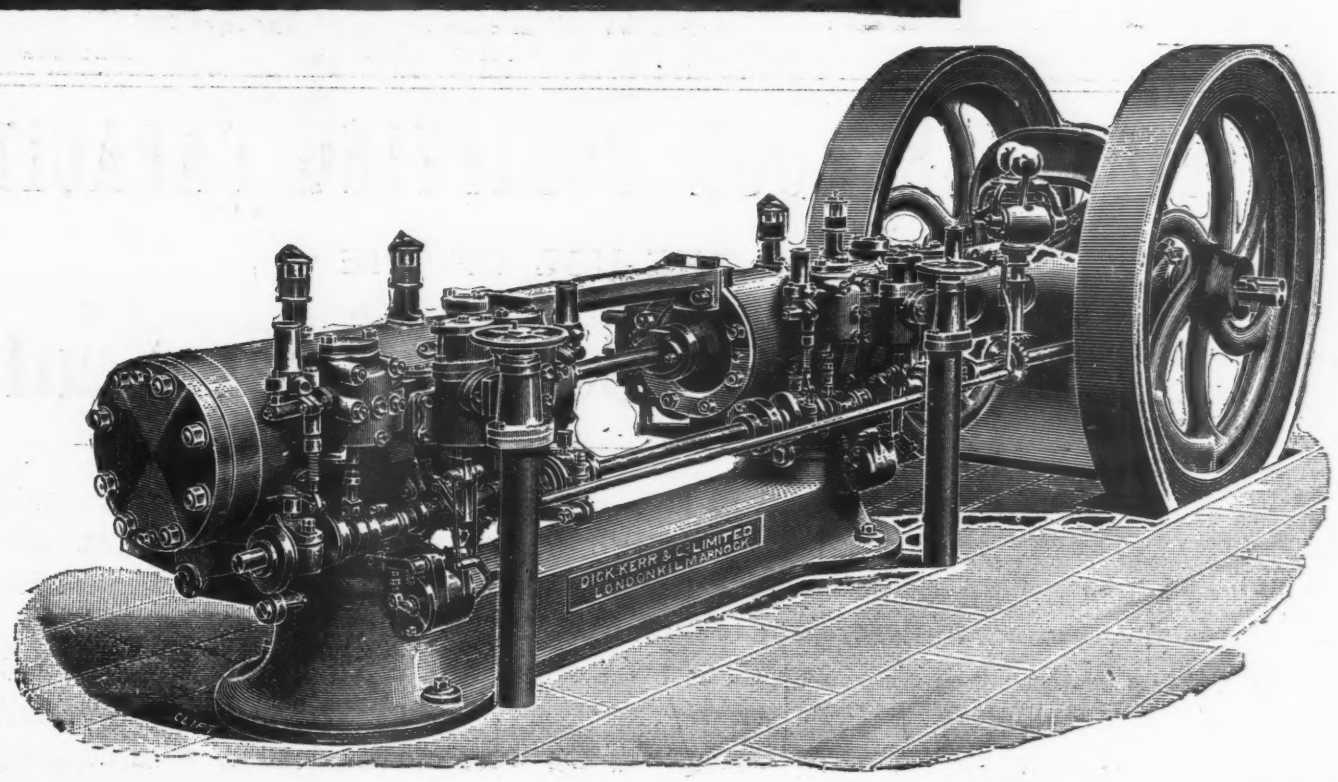
(Two Strokes.)

15 to 500 Horse Power.

For General Work and Isolated Electric Plants.

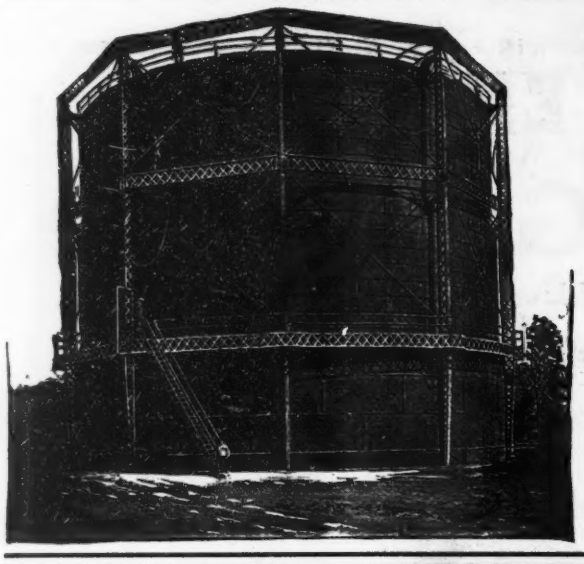
Tandem Cylinder. Impulse Every Stroke. 100 to 1,000 Horse Power.

For Central Stations and all work requiring extreme steadiness.



ESSENTIAL PRINCIPLE.—An impulse at each end of piston; using half force to each impulse; doubling the steadiness; reducing the wear on moving parts, and weight for given power. **CONSTRUCTION.**—The piston rod works through stuffing box in front end of cylinder, and connecting rod is carried in a cross-head working in a slide in frame, as in ordinary steam engine practice. All valves are of the poppet type, operated by cams on a single cam-shaft, giving positive movement to every working part. Tube or electric ignition. **RESULT.**—An engine of extreme simplicity and steadiness of action, the even wear on the cylinder and all working parts assuring increased economy, long life, and minimum cost in repairs. **RECORD.**—Successful and constant use in Great Britain for the past eight years. Address

W. W. GOODWIN, President, 532 Bourse Building, Philadelphia Pa. or
THE WESTERN GAS CONSTRUCTION CO. Bldrs. & Gen. Agts. Fort Wayne Ind.



DAVIS & FARNUM MFG. CO.,

WALTHAM, MASS.

Principal Office & Works, Waltham, Mass. Boston Office, R'm 18, Vulcan Bldg., 8 Oliver St.

Single, Double and Triple-Lift Gasholders of any Capacity. Tubular, Pipe and Sinuous Friction Condensers of all Sizes.

Steel Tanks for Gasholders, Iron Roof Frames and Floors, Purifying Boxes, Center Seal or Valve Connections, Bench Work, Reversible Lime Trays.

Self-Sealing and Pressed Steel Mouthpiece Lids.

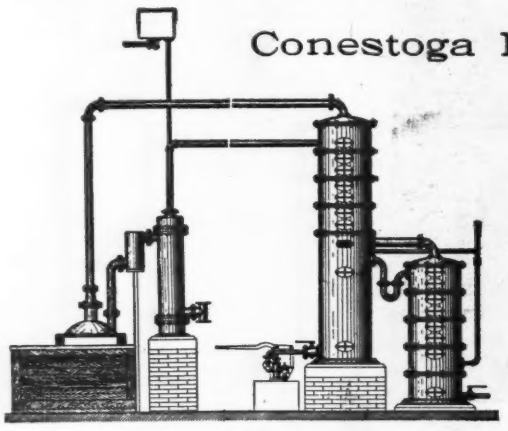
Coke Borrows, Coal Wagons, and all Apparatus Requisite for a Complete Gas Works.

Also, Gas and Water Pipe, Flanged Pipe, Sugar House Work, and Special Castings of all Descriptions.

GAS ENGINEERING COMPANY,

INCORPORATED,

Conestoga Building, PITTSBURGH, PA.



AMMONIA MACHINE.

MANUFACTURERS OF

Gas Works Machinery of all kinds,

PATENTEE AND OWNER OF

PITTSBURGH WASHER-SCRUBBER,

SOLE AGENT FOR

FELDMANN AMMONIA MACHINE,

For producing Sulphate, Aqua, Chloride and Concentrated Liquors.

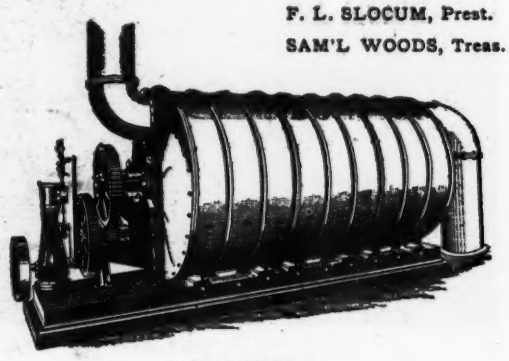
The Erection of Bi-Product Coke Ovens a Specialty.

Faux System of Recuperative Benches,

JAS. GARDNER, JR.
SOLE CONSTRUCTOR AND BUILDER.

NEW SYSTEM HYDRAULIC MAIN.

F. L. SLOCUM, Prest.
SAM'L WOODS, Treas.



SCRUBBER.

INCREASE YOUR PURIFYING CAPACITY

BY THE USE OF THE

"Crighton" Four-Box Center Seal Cap.

Having recently perfected and patented a Five-way Center Seal Cap, we are now in position to offer and recommend it to Gas Companies for increasing their purifying capacity at a moderate cost.

With this Cap you can have **all your Purifying Boxes in constant use,** and where four boxes are in operation at one time, **the capacity is increased one-third.**

Your present Center Seal can be used, and will **only require a new Cap.** Under ordinary circumstances **the change can be made in one day,** and will not necessitate the disturbing of your connections.

Now is the time to make the change, as the work can be done to good advantage during the season of your lightest output.

For information and prices address

KERR MURRAY MFG. CO.,

Manufacturers of Gas Works Apparatus and Holders,

FORT WAYNE, IND.

BARTLETT, HAYWARD & CO.

BALTIMORE, MD.

Triple, Double & Single-Lift

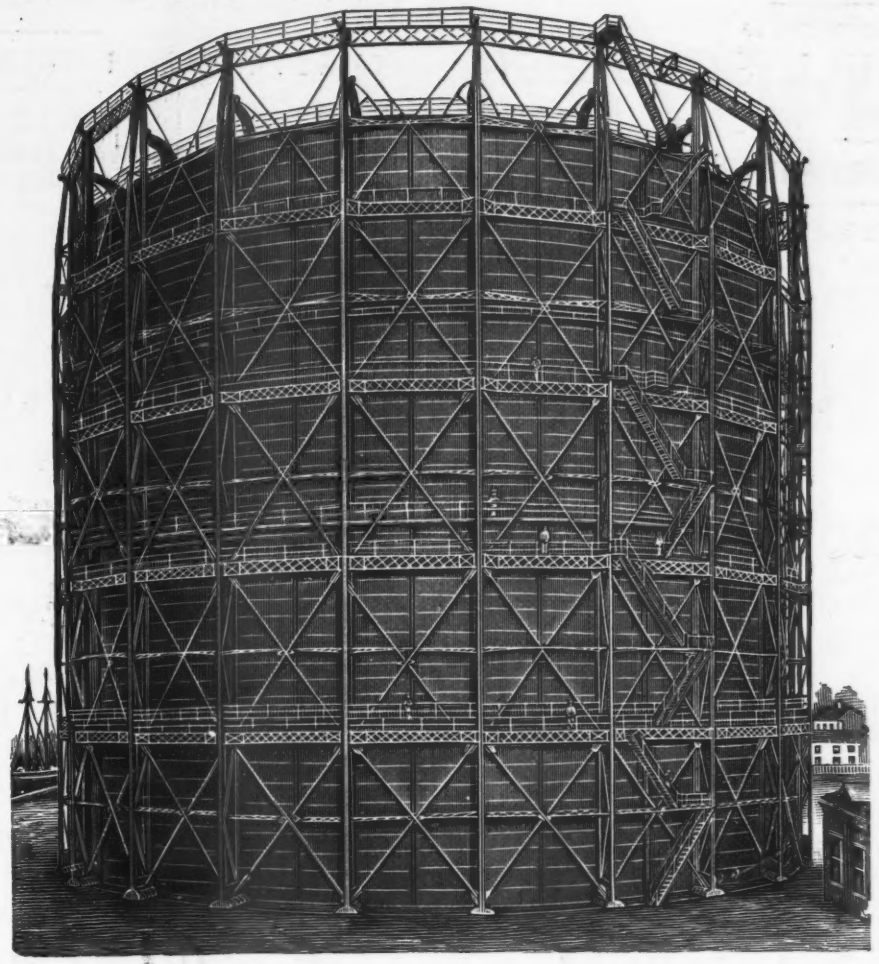
GASHOLDERS.

Iron Holder Tanks.

ROOF FRAMES.

Girders.

BEAMS



PURIFIERS.

CONDENSERS.

Scrubbers.

Bench Castings.

OIL STORAGE TANKS.

Boilers.

Three Four-Lift Gasholders, each of 4,289,500 Cubic Feet Capacity, Erected in Chicago.

The Wilkinson Water Gas Process.

THIRTY-CANDLE, NON-CONDENSABLE, FIXED GAS. THE MOST SUCCESSFUL GAS PROCESS IN OPERATION.

MILL'S REVERSIBLE LIME TRAYS.

Gas Works Designed and Constructed.

W. H. PEARSON, President. J. T. WESTCOTT, Gen'l Mang'r & Treas. L. L. MERRIFIELD, Chief Engineer.

The Economical Gas Apparatus Construction Co., Ld.

269 Front Street, East, - - Toronto, Canada.

ENGINEERS AND BUILDERS

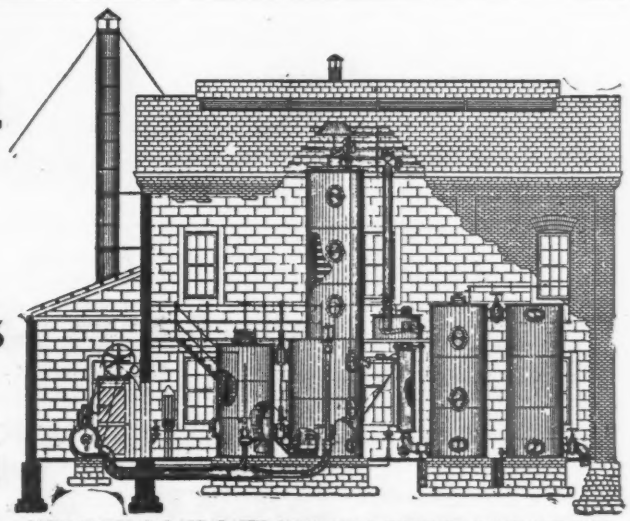
OF THE

Improved Lowe Water Gas Apparatus

Designed to give the Greatest Efficiency when using any kind of Oil, Anthracite Coal, Gas House or Oven Coke.

New Gas Works Built, Present Gas Plants, either Coal or Water, Remodeled

Catalogues, Plans and Estimates Furnished upon Application.



LOWE WATER GAS APPARATUS, MERRIFIELD-WESTCOTT-PEARSON SETTING.

Foundries and Works: { Millville, N. J. / Florence, " / Camden, "

R. D. WOOD & CO.

ENGINEERS, IRON FOUNDERS, MACHINISTS

400 Chestnut Street, PHILADELPHIA, PA.

MANUFACTURERS OF

CAST IRON PIPE

SOLE MAKERS OF

THE MITCHELL SCRUBBER

(PATENTED)

PURIFIERS, CONDENSERS, SCRUBBERS.

THE HOPPER AUTOMATIC GAS GOVERNOR.

BENCH WORK. PLATE GIRDERS.

IRON FLOORS AND ROOFS.

BUILDERS OF

GAS HOLDERS

Single, Double and Triple Lifts, with or without Wrought Iron or Steel Tanks

PEASE'S PATENT WIRE ROPE GUIDING FOR GAS HOLDERS

CUTLER'S
PATENT FREEZING PREVENTER
FOR GAS HOLDER CUPS.

THE TAYLOR REVOLVING BOTTOM GAS PRODUCER,
HEAVY LOAM CASTINGS, DUNHAM SPECIALS, HYDRAULIC WORK
LAMP POSTS, VALVES, ETC.

ISBELL-PORTER CO.,

ENGINEERS AND CONTRACTORS FOR THE

Construction and Extension of Gas Works.

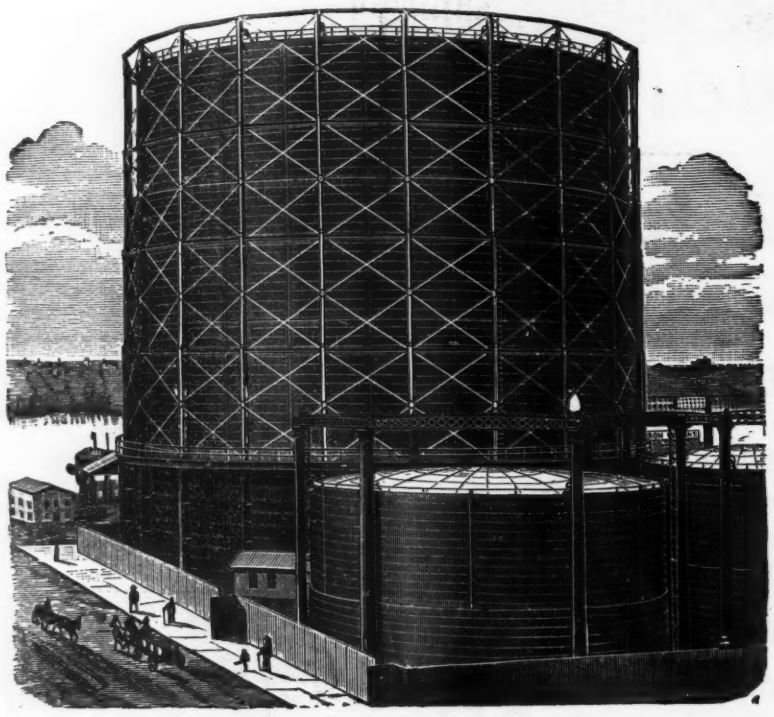
FOUNDERS AND MACHINISTS.

MANUFACTURERS OF

All Ironwork and Machinery Required in a Gas Plant.

Estimates, Drawings and Specifications furnished for the Alteration, Improvement, or Extension of Existing Works or the Construction of New Works.

245 Broadway, New York City. —OFFICES— Bridge & Ogden Sts., Newark, N. J.



The Continental Iron Works,

THOMAS F. ROWLAND, President.
WARREN E. HILL and CHAS. H. CORBETT, Vice-Presidents.
THOMAS F. ROWLAND, JR., Secretary & Treasurer.

BROOKLYN, N. Y.

TAKE EAST TENTH OR TWENTY-THIRD STREET FERRIES FROM N. Y. TO GREENPOINT.

BUILDERS OF

Gas Holders.

Single and Multiple Section Gas Holders a Specialty.

Wrought Iron Gas Holder Tanks.

BENCH CASTINGS, RETORT LIDS.

Hydraulic Mains, Condensers, Scrubbers
Purifiers, Valves, Etc.

Self-Sealing Retort Mouthpieces & Lids

For Round, Oval, or "D" Retorts.

ILLUMINATING GAS! FUEL GAS!

THE LOOMIS PROCESS.

Now in successful operation at Works of John Russell Cutlery Co., Turner's Falls, Mass., and Henry Disston's Son's Saw Works, Tacony, Pa.

The Cheapest Gas Generating System in the World.

Plans and Estimates Furnished.

BURDETT LOOMIS, - - Hartford, Conn.

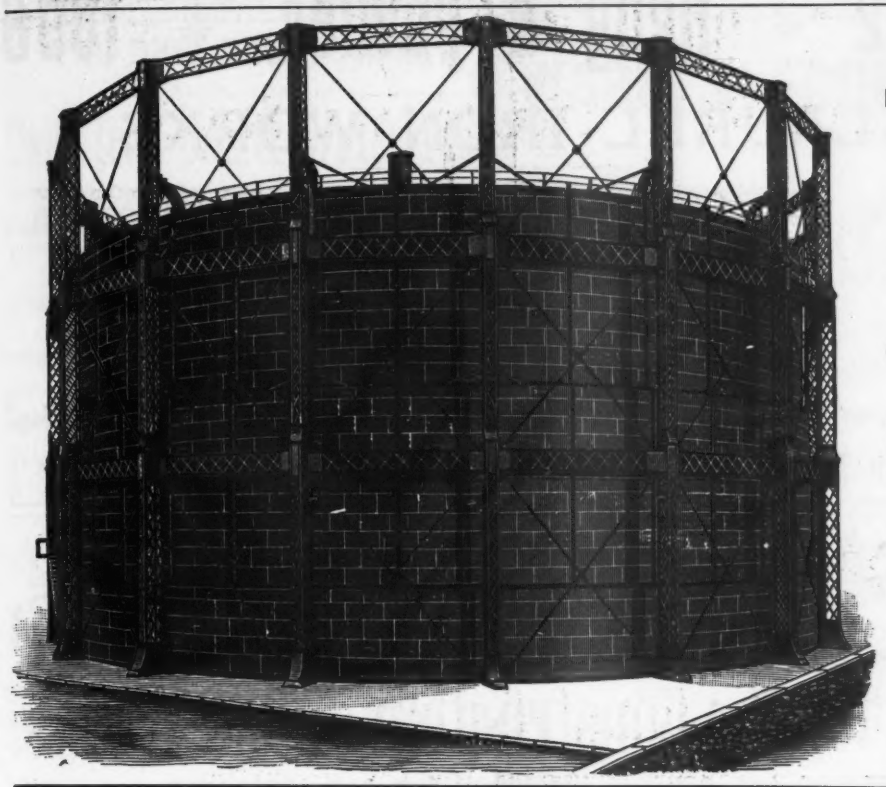
To Gas Companies.

We make to order CAP BURNERS to burn any amount under a stated pressure. Send for samples.

Also, SERVICE CLEANERS, DRIP PUMPS, and STREET MAIN PROVING APPARATUS.

C. A. GEFRORER,
248 N. 8th St., Phila., Pa.

GAS WORKS APPARATUS AND CONSTRUCTION. GAS WORKS APPARATUS AND CONSTRUCTION.



H. RANSHAW, Prest. & Mangr. T. H. BIRCH, Asst. Mangr
WILLIAM STACEY, Vice-Prest. R. J. TARVIN, Sec. & Treas.

THE STACEY MANUFACTURING CO
Established 1851.

Single, Double and Triple-Lift

GASHOLDERS,

Of any Capacity, with or without Wrought Iron or Steel Tanks.

Hydraulic Mains, Condensers, Scrubbers, Purifiers, Valves, etc.

Coal Gas Benches, Roof Frames,

OIL STORAGE TANKS.

Pressed Steel Mouthpiece Lids, Self-Sealing Mouthpiece Lids.

Cincinnati, Ohio.

George Shepard Page's Sons,

Sole Agents for

The "Standard" Washer-Scrubber,

The Walker Tar and Carbonic Acid Extractor, The Walker Sulphate and Ammonia Still,
The Walker Self-Sealing Pressed Steel Mouthpiece Lids.

The Berlin Center Valve. And Contractors for Ammoniacal Liquor.

No. 69 Wall Street, New York City.

Practical Hints
ON THE CONSTRUCTION AND WORKING OF
Regenerator Furnaces,
By MAURICE GRAHAM, C.E.
Price, $1.25.
A. M. CALLENDER & CO., 32 Pine Street, N. Y.

GEORGE R. ROWLAND.
Formerly with the Continental Iron Works.
Draughtsman and Constructing Engineer.
Drawings, Specifications and Estimates furnished for the construction of new works or alteration of old works. Special attention given to Patent Office drawings.
Office, No. 245 Broadway, N. Y. City.

T. G. LANSDEN,
Consulting and Contracting Gas Engineer
Estimates, Plans and Specifications for New Works (Coa or Water Gas), and for Extensions or Alterations.
Room H, 108 N. 4th St., St. Louis, Mo.

WM. HENRY WHITE,

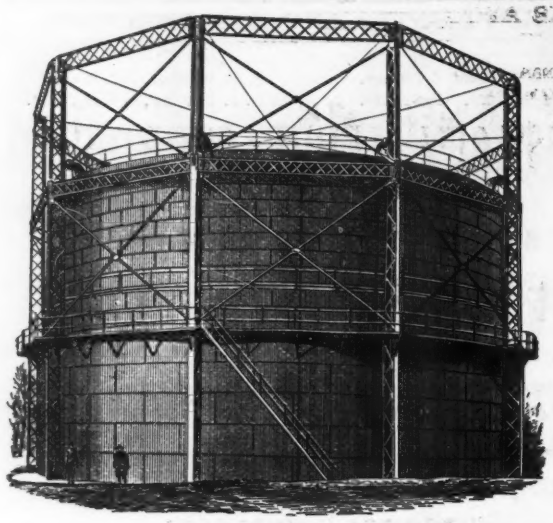
No. 32 Pine Street, - - - New York City.

ENGINEER AND CONTRACTOR FOR THE

ERECTION AND EXTENSION OF

GAS, WATER, AND ELECTRIC LIGHT WORKS.

Correspondence with Gas Companies contemplating extending or improving their Plants respectfully invited
Plans and Estimates Furnished.



1842 * Deily & Fowler, * 1896

LAUREL IRON WORKS.

Office, No. 39 Laurel Street, Philadelphia, Pa.

BUILDERS OF

Gasholders

Single or Telescopic. With or Without Iron or Steel Tanks.

OIL TANKS, WATER TANKS, AND GENERAL WROUGHT IRON WORK.

JAMES R. FLOYD & SONS, Successors to HERRING & FLOYD, Oregon Iron Works,

West 20th and 21st Streets, Between 10th & 11th Avenues, New York City.

Engineers and Contractors for the Construction of Gas Works.

MANUFACTURERS OF ALL KINDS OF CASTINGS AND GENERAL IRONWORK FOR GAS APPARATUS.

Bench Castings, Regenerative and Half Regenerative Furnace Castings, Condensers, Tower Scrubbers, Mechanical Scrubbers, Purifiers, Malleable Iron Retort Lids, Self-Sealing Retort Lids, Hydraulic Hoist Purifier Carriage, Crosses, Tees, Bends, Angles, Reducers, S-Bends, Sectional Sleeves, Plugs, Caps, Street Drips, etc., always on hand.

WOOD'S GAS SCRUBBING AND ENRICHING APPARATUS.

In use at Syracuse, Auburn, Watertown, Cortland and Geneva, N.Y.; Elizabeth, N. J.; Boston, Mass.; Jamaica Plain, Mass.; Providence, R. I.; Northern Liberties Gas Co., Phila.

Sole Manufacturers of the OGDEN QUICK-MOVING VALVE.

Premium Awarded, World's Columbian Exposition.

HEARNE CENTER SEAL, Operating One, Two, Three or Four Boxes.

SCIENTIFIC BOOKS.

GAS MANUFACTURE, by William Richards. 4to., with numerous Engravings and Plates, in Cloth binding. $12.

TECHNICAL GAS ANALYSIS. $3.

GAS CONSUMER'S HANDYBOOK, by Wm. Richards, C.E. 20 cents.

PRACTICAL TREATISE ON HEAT AND VENTILATION, with Special Relation to Illuminating, Heating and Cooking by Gas. By E. E. Perkins. $1.25.

CHEMISTRY OF ILLUMINATING GAS. By Norton H. Humphrys. $2.40.

PRACTICAL TREATISE ON HEAT By Thomas Box. 2d edition. $5.

PRACTICAL PHOTOMETRY: A Guide to the Study of the Measurement of Light. By W. J. Dibdin. $3.

CHEMICAL TECHNOLOGY: Vol. I., *Fuel and Its Applications*, $5. Vol. II., *Lighting*, $4.

IRONWORK: Practical Designing of Structural Ironwork. By H. Adams. $3.50.

GAS WORKS: Their Arrangement, Construction, Plant and Machinery. $5.

PRACTICAL HANDBOOK ON GAS ENGINES, by G. Lieckfield. $1.

LIQUID FUEL FOR MECHANICAL AND INDUSTRIAL PURPOSES. By E. A. Brayley Hodgetts. $2.50.

COAL, SPONTANEOUS COMBUSTION OF. By Thomas Rowan, C.E. $2.

COAL: Its History and Use. By Prof. Thorpe. $3.50.

THE GAS WORKS OF LONDON. By Colburn. 60 cents.

HEAT A MODE OF MOTION. By John Tyndall. $2.50.

THE MANAGEMENT OF SMALL GAS WORKS. By C. J. R. Humphreys. $1.

MANUAL FOR GAS ENGINEERING STUDENTS. By D. Lee. 40 cents.

THEORY OF HEAT. By J. Clerk-Maxwell. $1.50.

AMMONIA AND AMMONIUM COMPOUNDS. By Dr. R. Arnold. $2.

DIGEST OF GAS CASES. $5.

PRACTICAL HINTS ON REGENERATOR FURNACES By M. Graham. $1.25.

DISTILLATION OF COAL TAR AND AMMONIACAL LIQUOR. By Geo. Lunge. New edition. $12.50.

A TREATISE ON THE COMPARATIVE COMMERCIAL VALUES OF GAS COALS AND CANNELS. By D. A. Graham. $3.

A TEXT BOOK OF INORGANIC CHEMISTRY. By Prof. Victor Von Richter. $2.

ILLUMINATING AND HEATING GAS. By W. Burns. $1.50

HANDBOOK FOR MECHANICAL ENGINEERS. By H. Adams. $2.50.

TREATISE ON MASONRY CONSTRUCTION. Baker. $5.

GAS ENGINEER'S LABORATORY HANDBOOK. By Jno. Hornby, F.I.C. $2.50.

GAS LIGHTING AND GAS FITTING. By W. P. Gerhard. 50 cents.

PRACTICAL PLUMBING. By P. J. Davies. $3.

AMERICAN PLUMBING. By Alfred Revill. $2.

CEMENT; A Manual of Lime and Cement, their Treatmen and Use in Construction. By A. H. Heath. $2.50.

ELECTRICITY.

INDUSTRIAL PHOTOMETRY, with Special Application to Electric Lighting. By A. Palaz, Sc.D. $4.

ELEMENTS OF ELECTRIC LIGHTING, Including Electric Generation, Measurement, Storage and Distribution. By Philip Atkinson. $1.50.

ELECTRIC TRANSMISSION OF ENERGY. By G. Knapp. $3.

ELECTRICIAN'S POCKETBOOK. By Monroe and Jamieson. $2.50.

MAGNETISM AND ELECTRICITY. By J. Overend. 40 cts.

DYNAMO BUILDING. By F. W. Walker. 50 cents.

DOMESTIC ELECTRICITY FOR AMATEURS. By E. Hospitalier. $2.50.

PRACTICAL MANAGEMENT OF DYNAMOS AND MOTORS. $1.

PRACTICAL GUIDE TO THE TESTING OF INSULATED WIRES AND CABLES. $1.

ELECTRIC LIGHTING, by Francis B. Crocker, E.M. $3.

ELECTRIC LIGHT FITTING. $2.

PRACTICAL ELECTRICITY. $2.50.

ELECTRICITY FOR ENGINEERS. $2.50.

ELECTRIICITY, Its Theory, Sources and Applications. By John T. Sprague, M.I.E.E. $5.

The above will be forwarded by express, upon receipt of price. If sent by mail, postage must be added to above prices. We take especial pains in securing and forwarding any other Works that may be desired, upon receipt or order All remittances should be made by check, draft, or post office money order. No books sent C.O.D.

A. M. CALLENDER & CO., 32 Pine Street. New York.

GAS AND WATER PIPES.

THE OHIO PIPE COMPANY,

MANUFACTURERS OF

Cast Iron Gas & Water Pipe,

BRANCH AND SPECIAL CASTINGS.

Gas-House Bench Castings, Hydraulics, Lamp Posts, Flange Pipe and Specials, Architectural Castings, Building Columns, Joists, Cellar Grates, Sash Weights, etc.

GENERAL FOUNDERS AND MACHINISTS

Columbus, Ohio.

Cast Iron Pipe For Natural or Artificial Gas, Flange Pipe, Electric Light Posts.

The Addyston Pipe & Steel Co., Cincinnati, O.

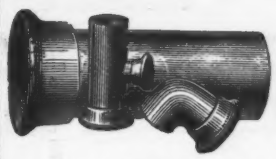
The Chemistry of Illuminating Gas.

By NORTON H. HUMPHRYS. Price, $2.40.

A. M. CALLENDER & CO., 32 PINE ST., N. Y. CITY.

GAS METERS.

WARREN FOUNDRY AND MACHINE CO.,



Established 1856. Works at Phillipsburgh, N. J.

New York Office, 160 Broadway.

CAST IRON WATER AND GAS PIPE,

FROM THREE TO FORTY-EIGHT INCHES DIAMETER. ALSO, ALL SIZES OF

Flange Pipe for Sugar House and Mine Work. Branches, Bends, Retorts, etc., etc

EASTERN OFFICE: NEW YORK, 192 BROADWAY. WESTERN OFFICE: CHICAGO, MONADNOCK BLK

M. J. DRUMMOND

MANUFACTURER OF CAST IRON

FLANGE GAS AND WATER PIPE

AND GENERAL FOUNDRY WORK

GEORGE ORMROD, Manger. & Treas., Emaus, Pa.
JOHN DONALDSON, Prest., Betz Bldg., Phila., Pa

EMAUS PIPE FOUNDRY.

DONALDSON IRON COMPANY. EMAUS, PA

MANUFACTURERS OF

CAST IRON PIPE AND SPECIAL CASTINGS

FOR WATER AND GAS.

Also, FLANGE PIPE, LAMP POSTS, Etc.

JOS. R. THOMAS,

No. 32 Pine Street, N.Y. City

CONSULTING AND CONSTRUCTING

Gas Engineer and Contractor

PLANS, SPECIFICATIONS AND ESTIMATES FURNISHED.

Contracts taken for all Appliance required at a Gas Works,

Either for New Works or Extensions to Old Plants

DAVID LEAVITT HOUGH,

26 CORTLANDT ST., N.Y. CITY.

Consulting Engineer

Investigations and Appraisals.
Designs and Estimates.

Contractor.

Machinery and Structures.
Gas and Water Pipe.

Special Agent for Selling & Purchasing

Temporary Address,

Care Messrs. Brown, Shipley & Co., London, Eng.

1894 DIRECTORY 1894

OF AMERICAN GAS COMPANIES

Price, - - - - - - - - - $5.00.

A. M. CALLENDER & CO., - - No. 32 Pine Street, New York.

PRACTICAL HANDBOOK ON

GAS ENGINES

With Instructions for Care and Working of the Same.

By G. LIECKFELD, C.E.

Translated with Permission of the author by GEO. M. RICHMOND, M.E.

Price, $1.00.

A. M. CALLENDER & CO., 32 Pine Street, New York.

Established 1849. With the best facilities for manufacturing, is enabled to furnish reliable work and answer orders promptly.

NATHANIEL TUFTS,

153 Franklin St., Boston, Mass.

C. W. HINMAN, - - Manager.

MANUFACTURER OF

DRY GAS METERS.

Station Meters of any Capacity.

Test and Experimental Meters, Pressure Registers, Pressure Gauges.

METER PROVERS, PHOTOMETERS, STREET LANTERNS, ETC., ETC.

Apparatus for the Chemical Testing of Gas and Gas Liquor.

CHARLES E. DICKEY. JAMES B. SMALLWOOD. CHARLES H. DICKEY.

THE MARYLAND METER AND MANUFACTURING CO.

Established 1866.

BALTIMORE, North & Saratoga Sts. **CHICAGO, 107 West Monroe St.**
NEW YORK, 838 Broadway. **SAN FRANCISCO, 221 Front St.**
BOSTON, 92 Water Street, Rooms 21 and 22.

CONSUMERS' & STATION METERS, PRESSURE GAUGES, Etc., Etc.

"Perfect" Gas Stoves

THE GOODWIN METER COMPANY,

1012-1018 Filbert Street, Philadelphia, Pa.

MANUFACTURERS OF

Consumers' and Station Meters,

Standard Photometrical and Analytical Gas Apparatus

"SUN DIAL" GAS COOKING AND HEATING STOVES.

Particular attention given to Repairing Meters and Scientific Apparatus. . . .

GEORGE B. EDWARDS, Agent,
113 Chambers Street, N. Y. City.

METRIC METAL COMPANY,

MANUFACTURERS OF

DRY GAS METERS

For all Kinds of Service.

ALSO MAKERS OF THE

MATCHLESS CLASSIC GAS COOK STOVES AND RANGES.

Send for '96 Stove Catalogue. Factory at Erie, Pa.

GAS METERS. GAS METERS. GAS METERS.

THE AMERICAN METER CO.

Established 1834. Incorporated 1863.

WET AND DRY GAS METERS. PRESSURE REGISTERS. METER PROVERS.
STATION METERS. PRESSURE & VACUUM REGISTERS. PORTABLE TEST METERS.
EXHAUSTER GOVERNORS. PRESSURE & VACUUM GAUGES. EXPERIMENTAL METERS.
DRY CENTER VALVES. CRESSON GAS REGULATORS. AMMONIA TEST METERS.
GOVERNORS FOR GAS WORKS. MARSLAND WATER METERS. BAR & JET PHOTOMETERS.

Manufactories:
512 West 22d St., N. Y.
Arch & 22d Sts., Phila.

GAS STOVES.
SUGG'S "STANDARD" ARGAND BURNERS,
SUGG'S ILLUMINATING POWER METER,
Wet Meters with Lizar's "Invariable Measuring" Drum.

Agencies:
125 & 127 S. Clinton Street, Chicago.
810 North Second Street, St. Louis.
222 Sutter Street, San Francisco.

HELME & McILHENNY,

Established 1848. **1339 to 1349 Cherry Street, Philadelphia, Pa.**

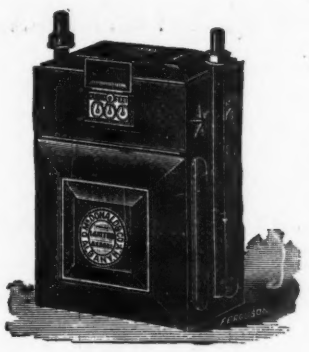
MANUFACTURERS OF

Wet and Dry Gas Meters, Station Meters, Provers, Gauges, Etc.

METERS REPAIRED

PREPAYMENT GAS METERS.

Our Own Patents. Strong. Simple. PROMPT ATTENTION. CORRESPONDENCE SOLICITED.



D. McDONALD & CO.,

Established 1854.

511 West 21st Street, NEW YORK CITY.
51, 53 & 55 Lancaster St., ALBANY, N. Y.
34 & 36 W. Monroe St., CHICAGO, ILL.

MANUFACTURERS OF

Wet and Dry Gas Meters

STATION METERS, EXPERIMENTAL METERS, METER PROVERS, PRESSURE & VACUUM REGISTERS & PRESSURE GAUGES.

Meters of all makers Thoroughly Repaired.

THEODORE D. BUHL, President. CHARLES H. JACOBS, Vice-President and Managing Director.

BUHL STAMPING CO. TRADE MARK RELIABLE GAS METERS DETROIT, MICH. U.S.A.

Buhl Stamping Company,

MANUFACTURERS OF GAS METERS,

Meter Repairing a Specialty.

Third, Fourth, Congress and Larned Streets, = = = = DETROIT, MICH.

We claim Superiority in Construction and unequaled facilities for making prompt deliveries to all parts of the country. *Mail and Telegraph Orders Solicited.*

THE ONLY METER FACTORY IN THE WORLD WHICH MANUFACTURES ITS OWN TIN PLATE.

The advertisement of

JOHN J. GRIFFIN & CO., Mfrs. of Gas Meters, etc.,

Nos. 1513, 1515, 1517, 1519 & 1521 Race Street, Philadelphia,
52 Dey Street, New York, 75 N. Clinton Street, Chicago,

Occupies this page every alternate week

UNEQUALED

For efficiency and low gas consumption.
For smooth and quiet running.
For simplicity of construction and grace in design.
For general reliability.
For close regulation of power.

150 MEDALS AND DIPLOMAS.

The "OTTO"--The First.

The First to use the four-stroke cycle. **The First** to admit well measured and distinct charges of gas into an air space. **The First** in the adoption of poppet valves. **The First** to develop the tube igniter, with automatic or timed firing. **The First** to have a reliable electric and a practical magnectic igniter.

THE FIRST SMOOTH RUNNING & NOISELESS GAS ENGINE COMBINING EFFICIENCY & SIMPLICITY.

Our Columbian Style

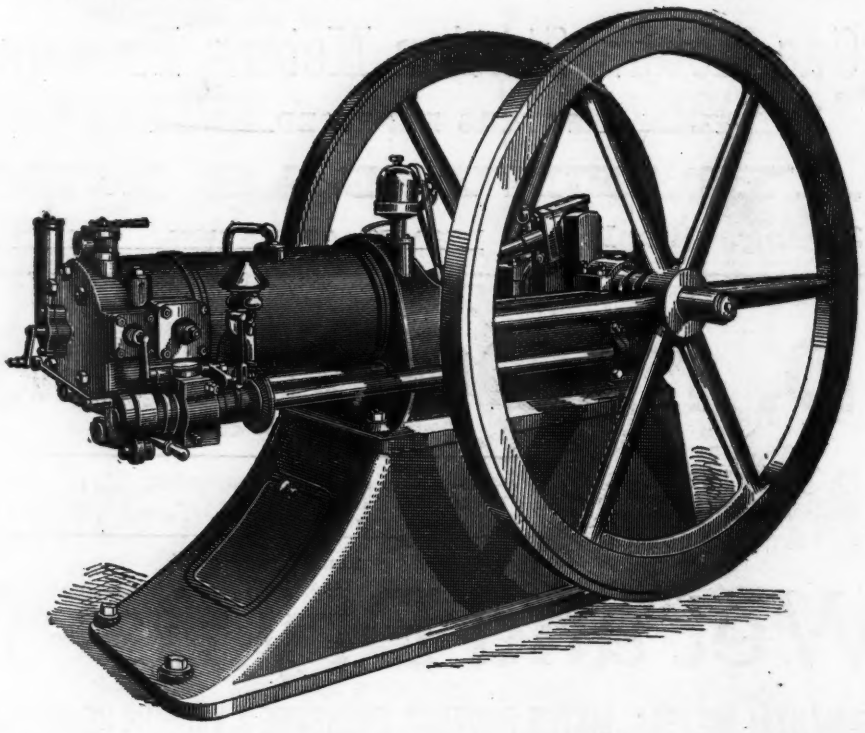
IS FITTED

With removable seats and casings for all valves.

With Patent Alloy Tube, good for one year.

With timing device for ignition, preventing starting backward; or with electric igniter.

OVER 45,000 SOLD.



SIMPLICITY, as far as is possible, with good design and perfect Working. Built on scientific principles, with a view to **HIGHEST EFFICIENCY**

Sizes,
One to 250 H.P.

The First and Only Engine To-day to Please Every Purchaser

DEMONSTRATION

It is almost a quarter of a century since the "Otto" revolutionized old and bad practices by introducing principles of combustion "entirely new" in the construction of Gas Motors.

A quarter of a century of uninterrupted success has demonstrated the correctness of these principles.

The gas engine history of the past proves that all competitors have recognized this fact by becoming imitators.

Since its advent the "Otto" engine has been illustrating mechanical improvement without alteration, while others have been offering alterations as improvements.

The experience of the past shows that it requires years to determine the real merits of a gas engine, and that nearly all new gas engines prove failures. **The fittest survive, and the only safe thing to do** in selecting a gas engine is to buy what the tests of practical use, through a long period of time, have proven to be the best.

The Practical Tests of a Quarter of a Century have Demonstrated that the "OTTO" Stands To-day Unrivaled

For simplicity of construction and grace in design; for general reliability and ease of management; for quiet and smooth running qualities; for efficiency and low gas consumption; for regularity of speed and close regulation of power.

"OTTO GAS ENGINE WORKS," Inc., 33d & Walnut Streets, Phila., Pa.

NEW YORK 18 Vesey St BOSTON, 19 Pearl St. CHICAGO, 245 Lake St.